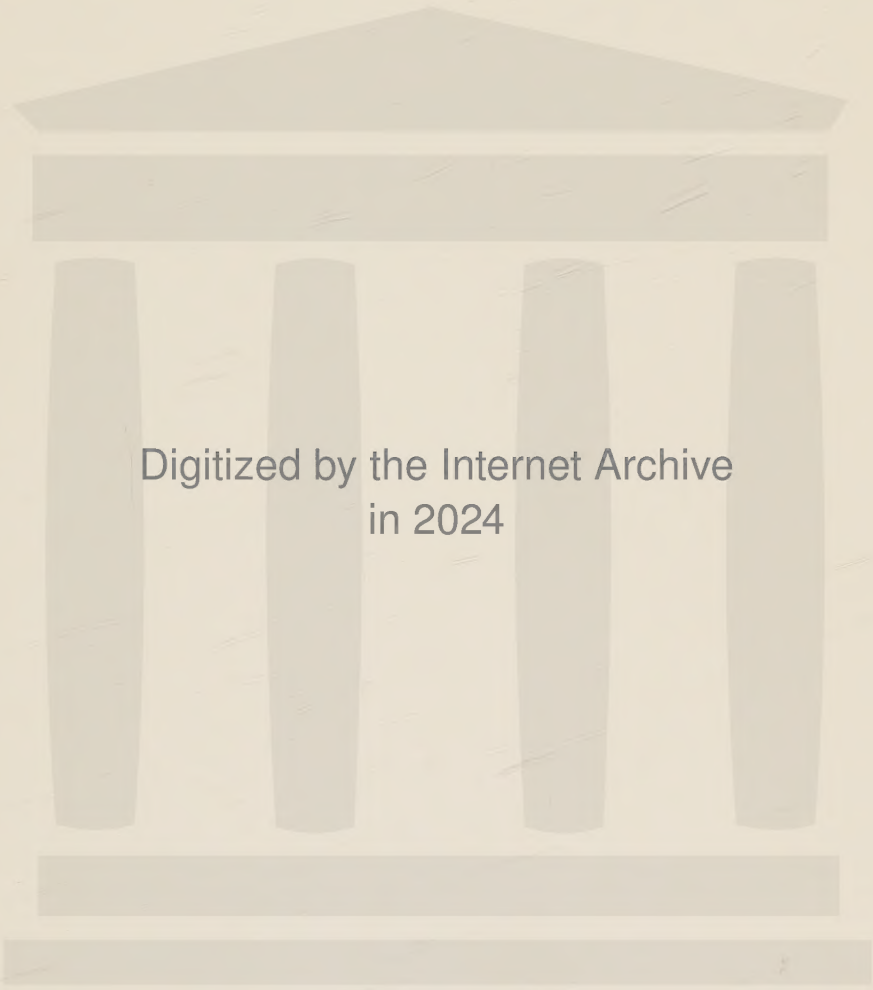

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THE PACIFIC

RUSSIAN SCIENTIFIC INVESTIGATIONS

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PREFACE

This book has been prepared for the Third Pan-Pacific Congress, in which our Union had the first occasion to take part.

Far reaching scientific and practical problems unite together the family of nations inhabiting the coasts of the Pacific by bonds of common interest, and the great scientific acquisitions of the past give confidence in a yet greater future. Not by disconnected efforts of separate countries, but in a mighty spirit of cooperation may the nations of the world conduct their researches in future.

In these days of the union of representatives of science from many countries, the Academy of Sciences of the USSR, in association with various scientific bodies of a renovated country, is happy in issuing this book which contains a record of the researches of Russian travellers and investigators in the vast expanse of the Pacific throughout a period of two centuries.

October, 1926

A. Fersman

Russian Discoveries in the Pacific

by L. Berg

I

The Russians made geographical discoveries in the following parts of the Pacific Ocean: 1) in the Bering Sea and Northern Pacific, 2) in the tropics during circumnavigations of the globe, and 3) in the south (Antarctic part) during the expedition of Bellingshausen.

The Russians first appeared on the Pacific in the year 1639.

Expedition of Moskvitin 1639—42. The ataman[1] Dmitri Kopylov, who was sent from Tomsk to the Lena, in 1637 founded a fort at the junction of the rivers Maya and Aldan. In 1639 he sent a cossack Ivan Moskvitin with thirty-one men up the river Maya. They crossed the mountains and came to the coast of the Okhotsk Sea at the mouth of the river Ulya to the west of the present town of Okhotsk, where they founded a zimovie[2] for collecting the yasak.[3] During the following years men from Moskvitin's detachment explored the coast of the Okhotsk Sea, eastwards to the Taui Bay and south as far as the river Uda, where they founded the Uda Fort.[4] From the mouth of the river Uda the cossacks went further east, in the direction of the mouth of the Amur. On his return to Yakutsk in 1642, Moskvitin told the voevoda[5] Golovin that „they went from the river Uda by the right hand side of the sea and there got hold of a Tungus man, and that same Tungus spoke to them of a river rich in crops and wanted to lead them to that same fertile river Shilka".[6]

1 ataman, chieftain.

2 zimovie, winter quarters.

3 yasak, tribute paid in furs.

4 J. E. Fischer. Sibirische Geschichte (see Bibliography at the end of this paper).

5 voevoda, governor, head administrator.

6 Proceedings („Chteniya") of the Society for the History and Antiquities of Russia. Moscow, 1861, fasc. 1, book 1st, part V, p. 2 (Russian).

The information on these rich lands in the basin of the Amur induced the authorities of Yakutsk to send a special expedition to that region.

Expedition of Poyarkov 1643—46. In the summer of 1643 the chieftain Vassili Poyarkov was sent from Yakutsk to the rivers Zeya and Shilka. He reached the place where, at the junction of the rivers Zeya and Amur, is now situated Blagoveshchensk; from there he went down the river to the mouth of the Amur, where, together with his sixty men, he spent the winter. That occurred in 1644. In the spring of the next year Poyarkov went out on the Okhotsk Sea in small river vessels and after three months voyaging, reached the river Ulya, where he met the men of Moskvitin's party.[1] This heroic expedition of the courageous men of the olden times, on unknown rivers and the cold and unexplored sea, involuntarily evokes our admiration. After wintering on the river Ulya in 1646 Poyarkov returned to Yakutsk, across the mountain range by way of the rivers Maya and Aldan, with only thirty-three of his men, having lost a hundred men during his three years' expedition, but bringing back with him charts of the route and a detailed account of his voyage. In this way Poyarkov had acquired very valuable geographical information. He was the first European to sail on the river Amur and the Okhotsk Sea.

It must be noted that when the voevoda of Yakutsk, Peter Golovin, was despatching Poyarkov to the rivers Zeya and Shilka he entrusted to him the solution of some geographical problems. The written instruction to Poyarkov contained the following:[2] „Whilst on the river Zeya, Vassili has to enquire of the natives in detail, about the tributaries of the Zeya, and what kind of people live on the banks of these tributaries, and if they are settlers or nomads, and if they sow crops, and if they have any other wealth, and if there is on the river Zeya silver, copper, or lead ore, and what this people will relate must be accurately written down. The charts and the report of his route through the mountain range and on the rivers Zeya and Shilka and their tributaries and of the lands, must all be sent to Yakutsk Fort

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[1] Supplements („Dopolneniya") to the Historical Acts, III, St. Petersburg, 1848, p. 55 (see Bibliography).

[2] They are printed in the above-mentioned book of „Chteniya" for the year 1861.

(„Ostrog") together with the tributes in cash; and the charts and report are to be signed by his own, Vassili's, hand".

The expedition of Stadukhin 1647. The coasts of the Okhotsk Sea, to the north of the Taui Bay, were explored by the famous northern navigator Michael Stadukhin. In 1647 he travelled overland from the Kolyma to the Anadyr river and „from the Anadyr he went in winter, on snowshoes and on sledges, with his comrades round the cape to the river Penzhina", of which Stadukhin relates that it is treeless and is inhabited by many clans, that are called the Koryaks. From thence he crossed over to the river Gizhiga, where he also found the same people of Koryaks. „The upper course of the same river is called Chondon, and the people that live there are the Khodyntsi men — the Yukaghirs". From the Ghizhiga, „I travelled by sea", writes Stadukhin, „in boats to the Viryamda, and this river is also called Tovui (Taui); here were living the Tungus". From the Taui Stadukhin went across to the river Okhota.[1]

In this manner, from 1639 to 1647 Russians explored all the coastline of the Okhotsk Sea from the mouth of the Amur to Penzhina Bay.

Expedition of Dezhnev 1648. The first man to cross the Bering Strait was Semen Dezhnev, a cossack from Yakutsk, born in Ustyug (Vologda gvt). The reports of his voyages were found in the archives of Yakutsk in 1736 by the celebrated historian Gerhard Friedrich Müller, who gave an account of them in the „Sammlung russischer Geschichte", III, 1758.[2]

On the 20th of June 1648 Dezhnev sailed from the mouth of the Kolyma eastwards. In September he doubled the „Bolshoi Kamennoi Nos" (The Great Stone Cape), now Cape Dezhnev, where he saw the Eskimo (called by him Chukchee); opposite the cape he saw „two islands and on these islands live Chukchee who have their lips cut and wear a tooth (bone) of a fish (a labret made of walrus' tusks)". He here refers to the two islands in the Bering Strait, Diomede, or

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[1] This information is publisbed in the paper by H. Ogloblin. East Siberian Arctic Navigators. Journal of the Ministry of Education, May 1903, p. 42 (Russian). See also: Supplements („Dopolneniya") to the Historical Acts, IV, 1851, p. 120—122.

[2] The copies of Dezhnev's original reports are printed in the „Dopolneniya", vol. IV, 1851, p. 8—27; for particulars see L. S. Berg. An account of Bering Strait and its coast prior to Bering and Cook (see Bibliography).

Gvozdev, which were then and are at present inhabited by the Eskimo, who wore bone labrets about their mouths (the Chukchee never wore these decorations). Storms then began which drove Dezhnev's boats („kotchi") all over the sea until after the 1st of October, when they were thrown out on the shore south of the mouth of the river Anadyr. From the place of their shipwreck to the mouth of the river they had to travel for ten weeks. During the summer of the next year Dezhnev founded on the middle course of the river Anadyr a zimovie—later the „Anadyr Ostrog" (Fort).

The Siberian pioneers of the XVIIth century supplied their authorities with maps of the countries they had visited. So did Stadukhin, Dezhnev and others. The voevoda of Tobolsk, Peter Godunov, making use of all this material, ordered a map of Siberia to be compiled and printed in Tobolsk. This first Russian printed map („Chertezh Sibirskiya Zemli") was published in Tobolsk in 1667 (see the facsimile on p. 5, copied from L. Bagrov). On the „Chertezh" may be seen the river Amur and Kamchatka; the way from the mouth of the Lena to the mouth of the Amur is shown to be open (navigable).

In 1672 the „Chertezh" of the year 1667 was corrected, redrawn and reprinted (see the facsimile, p. 7). In an explanatory note under the title „Spisok s Chertezha Sibirskiya Zemli" are given particulars of the rivers which flow into the Pacific Ocean.[1]

In the curious „Narrative relating to the great river Amur, that separates the Russian and Chinese settlements", composed in the second half of the XVIIth century (before 1689), is given a detailed description of the river Amur.[2] There is also mentioned (p. 110) for the first time the Island of Sakhalin: „The above-named great river Amur flows through a country of hills and forests and falls into the Ocean by a single mouth, and opposite this mouth is a large island; and this island is inhabited by many foreign people, namely, the Ghilyaks. Their huts („yourty") are made of logs, and the dresses they wear are of sable and fox and the skins of animals, and they go about on dog sledges in winter and in boats (on the water) in summer; they keep dogs by hundreds,

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[1] This document is printed in the book by A. Titov. Siberia in the XVIIth century, Moscow, 1890 (see Bibliography).

[2] Printed in the book by Titov, p. 105—113.

Fig. 1. MAP („CHERTEZH") OF SIBERIA BY PETER GODUNOV, 1667 (from Bagrov).
(The first Russian printed map).

some have five hundred and some up to a thousand; they feed on venison and fish".

The information Moscow and Tobolsk had at the end of the XVIIth century with regard to the Far East was embodied in the „Chertezhnaya Kniga Sibiri" (Map Book of Siberia) by Semen Remezov, 1697—1700.[1] There on a map bearing the title of „Chertesh vsekh Sibirskikh gradov i Zemel", 1698, (Map of all the Siberian towns and lands) is drawn the river Kamchatka, and also the „Island of Kamchatka", situated opposite the mouth of the river Uda. There are also „Islands of Japonia" and Corea.

Discovery of Kamchatka by Atlasov in 1697—99. The first information about Kamchatka was brought to the Russians by the Koryaks in the middle of the XVIIth century. But the honour of the discovery and geographical description of that land belongs to the prikashchik[2] of the Anadyr Fort, Vladimir Atlasov.[3]

In 1696, Lucas Morozko, a cossack of Yakutsk, was sent from Anadyrsk to the Koryaks on the river Opuka (Opuka flows into the Bering Sea in latitude 62° N). But he went further south, namely to the river Tigil. At the beginning of the year 1697, Atlasov left Anadyr with sixty attendants and sixty Yukaghirs. From the mouth of the river Penzhina they travelled for a fortnight on reindeer, following the western coast of Kamchatka, and then turned eastward to the shores of the Pacific Ocean, to the Oliutora Koryaks (Oliutortsy) that inhabit the banks of the river Oliutora. This occurred in February 1697. On the Oliutora, Atlasov divided his party into two: one party he ordered to follow the eastern coast of Kamchatka southwards, and the other, which he led himself, went by the western coast to the Palan river (which falls into the Okhotsk Sea in the latitude 59° N); from thence they went to the mouth of the Tigil and at last to the river Kamchatka, where he arrived on the 18th of July, 1697. Here it was that the Russians for the first time met the Kamchadales. From thence Atlasov went southward following the western coast

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[1] First edited by the Russian Archaeographical Commission in 1882, St. Petersburg, folio.

[2] prikashchik, an agent, a petty officer.

[3] For the authentic documents of the discoveries of Atlasov, see the Proceedings („Chteniya") of the Society for History and Antiquities of Russia, Moscow, 1891, book III, part I, p. 1—18. For a detailed analysis see L. S. Berg. Discovery of Kamchatka and the Kamchatka expeditions of Bering. Petrograd, 1924, chapter 1.

Fig. 2. MAP („CHERTEZH") OF THE WHOLE OF SIBERIA TO THE CHINESE REALM, 1672 (from Bagrov).
(2nd edition of the map reproduced on p. 5).

of Kamchatka and reached the river Golygina (south of Bolsherietsk), were lived the Kurils. From the mouth of this river (latitude 52°10′ N) Atlasov „seemed to descry islands on the sea" — this would obviously refer to the nothernmost Kuril Island, Alaid.

From the river Golygina, Atlasov returned on the 2nd of July, 1699 to Anadyrsk. Thus was discovered Kamchatka. Atlasov gave also a remarkable geographical description of this country.

The first Russian voyage to Kamchatka by the Okhotsk Sea took place in the year 1716. A ship built at Okhotsk was brought to the mouth of the river Tigil. For the idea of discovering this route, we are indebted to Peter the Great who, as early as the year 1713 ordered men to be sent across the Lamsk (Okhotsk) Sea to find out the Kamchatka passage.

Discovery of the Northern Kuril Islands. In 1706, Michael Nasedkin after having reached the Cape of Lopatka, became convinced that there was land on the other side of the strait. When this news reached Yakutsk an order was sent to Kamchatka (9th September, 1710): „make ships suitable for the occasion and search thoroughly for lands beyond the straits and mark them on the chart". In accordance with this order, in August 1711, Danila Antsiferov and Ivan Kozyrevskoi went from the Bolshaya River (Kamchatka) to Cape Lopatka („Kamchadal Nos") and from here on smaller ships and on canoes to the first Kuril Island, now Shumshu. This island, as also the southern extremity of Kamchatka, was not inhabited by pure Kurils (Aĭnu), but by half castes of Kurils and Kamchadales. From Shumshu the travellers went to Paramushir, where lived pure Kurils. From thence, on the 18th of September, 1711 they went back to Bolsherietsk, bringing with them a chart of the islands they had visited. From the narratives of the Kurils and Japanese (wrecked on the Kamchatka shores), Kozyrevskoi gave a detailed account of the whole chain of the Kuril Islands, accompanied with charts.

In 1738 Spanberg, one of the staff of Bering's expedition, mapped all the Kuril Islands.

The coasts of the Bering Strait. Long before Cook (1778), Russians knew of the existence of land beyond Cape Dezhnev, and there was even a special name for America—Bolshaya Zemlya (The Great Land). Of this land a detailed account was given in the year 1711,


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ТИХОЕ МОРЕ
ПЕНЖИН СКОЕ МОРЕ
Заливъ Св. Креста

at the Anadyr Fort by a Yakutsk officer, Peter Popov.[1] In 1726, Afanasi (Athanasius) Shestakov, a golova (headman) of the cossacks of Yakutsk, brought to St. Petersburg a chart on which, opposite the far northeast of Siberia, was drawn a coast under the name of „Bolshaya Zemlya".[2] At St. Petersburg Shestakov was ordered to bring under subjection the rebellious Chukchee and to explore the land opposite the Chukotsk Cape. In the spring of 1730 he perished in the region of Penzhina Bay, but his successor, captain Pavlutski, sent in the autumn of 1730 an expedition to the coast of the Bolshaya Zemlya under the command of navigator Ivan Fedorov, whose assistant was the geodesist Michael Gvozdev. In August 1732, they landed on the coast of the Bolshaya Zemlya, near the Prince of Wales Cape. They also surveyed the islands in the Bering Strait (the Islands of Diomede, or Gvozdev), and discovered an island now called King's Island, or Ukivok.[3] A map drawn according to Gvozdev's journals was lost, but in the middle of the XVIIIth century the discoveries of Fedorov were very well known in St. Petersburg, and in a map drawn by Gerhardt Müller and published by the Russian Academy of Sciences in 1758 under the name „Nouvelle carte des decouvertes faites par des vaisseaux russiens aux côtes inconnues de l'Amerique Septentrionale avec les pais adiacents" we see in the strait between Asia and America, opposite to the Island of Diomede, a coast (part of North America) ending at latitude 66° N in a cape with the inscription: „Côte découverte par le Geodesiste Gwozdew en 1730" (the coast was actually discovered in the year 1732).

So it happens that the first to discover the strait between Asia and America were neither Dezhnev nor Bering, but Fedorov, who not only saw the islands of Gvozdev and the opposite shores of Asia and America, but also was the first to map them.

What knowledge the Russians had in the XVIIIth century of the American coast of Bering Strait, can be seen from my paper in the „Notes („Zapiski") on Hydrography", vol. 43, 1920, chapter 7.

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[1] Documents pertaining to the History of Siberia, vol. 1 (1700–13), St. Petersburg, 1882, p. 456–459 (see Bibliography).

[2] This drawing was first printed by F. A. Golder in his „Russian Expansion on the Pacific 1641–1850", Cleveland, 1914, p. 111. Reprinted by L. Berg in „Notes on Hydrography, XVIII" (see Bibliography).

[3] A. Sokolov. The first Russian voyage to America. Notes („Zapiski") of the graphic Department, IX, 1851, p. 78–107 (see Bibliography.

Bering's expeditions in 1725—1743. In a memorandum written by Leibnitz in 1697 and dealing with reforms in Russia the philosopher points out, by the way, the necessity of exploring the coasts of northeastern Asia, „to ascertain whether Asia and America are connected or are separated by a strait". As we have seen, this problem had already been solved by Russian navigators, and in Siberia it raised no doubt. But of this Leibnitz was not aware, and for twenty years he did not cease reminding Peter the Great of the necessity of solving that question.

Three weeks before his death, on January 6, 1725, Peter the Great wrote with his own hand an order, in which Bering was charged to build ships in Kamchatka and to go on these ships northward to search „where Asia and America met".[1]

On the 5th of February, 1725, Bering left St. Petersburg and arrived at Nizhnekamchatsk only in March 1728. At that place the ship „*St. Gabriel*" was built. On the 13th of July he sailed from the mouth of the Kamchatka out to sea. He had on board lieutenant Alexis Chirikov. On the 10th of August they discovered in the Bering Sea the Island of St. Laurence. The „*St. Gabriel*" then entered the strait now called the Bering Strait. On the 15th of August they reached the latitude 67°18′ N, and not seeing any land to the north, they turned back. On their way back they discovered the Island of St. Diomede (there are really two islands). The American coast of the strait Bering did not see. On his return to St. Petersburg in March 1730, Bering submitted a chart of the regions he had visited. This chart was first used by Ivan Kirillov in 1734 for his map „Imperii Rossici Tabula Generalis"; abroad it was published in the 4th volume of the work by the jesuit Du Halde „Description de la Chine", Paris, 1735, and also in the atlas of D'Anville, „Atlas général de la Chine", Paris, 1735. In Russia a copy of Bering's original chart was first published by L. S. Bagrov in his essay „Karty Asiatskoi Rossii" (Maps of Asiatic Russia), Petrograd, 1914, pp. 19.

At St. Petersburg Bering submitted a proposal for undertaking another expedition, in which he was to explore the coast of America.

[1] For the literature and details of the expedition of Bering see: L. Berg. The Discovery of Kamchatka and the Kamchatka Expeditions of Bering, Petrograd, 1924 (see Bibliography).

His plan was approved and he was appointed commander of the expedition with Chirikov as first mate and Spanberg as second. This expedition was a large enterprise, its staff being composed of as many as five hundred and seventy men. In February, 1733 the expedition started from St. Petersburg in parties. Bering and Chirikov were ordered to build ships at Okhotsk or in Kamchatka and to go with two vessels to explore the supposed American coast, to find out what kind of people lived there, the name of the country, and if it was really the American coast. Spanberg was commissioned to go with three ships and to investigate the Kuril Islands and then go to Japan to enter with the Japanese into friendly relations. In the summer of 1737 Bering and Chirikov came to Okhotsk. In June 1740 only were launched the two packet-boats, the „*St. Peter*" and „*St. Paul*", each being eighty feet long and having a capacity of a hundred tons. On the 4th of June of the following (1741) year the „*St. Peter*" under the command of Bering and the „*St. Paul*" commanded by Chirikov sailed out from Petropavlovsk harbour. The famous naturalist Steller was aboard the „*St. Peter*". On the 20th of June the ships lost sight of each other. After cruising for a month and a half, on the 16th of July in latitude 38°14′, the „*St. Peter*" sighted a big mountain and snow covered ranges. This was the mount of St. Elias in Alaska. Slowly progressing towards the coast they approached on the 20th of July an island to which they gave the name of St. Elias and which now bears the name of Kayak (latitude 59° 57′ N).

These places had not been visited by Europeans before Bering. Steller went ashore and made many valuable observations on its natural history. Although he spent only one day there, he was able to describe one hundred and sixty species of plants. The island was inhabited, but when the Europeans approached, the natives hid themselves. Steller very minutely described all the articles of their daily life that came under his observation. Very likely the tribes that lived there were the Ugalentsi, or Ugalakhmut, the Eskimo that had fallen under the influence of the Tlinkit-Indians.

On July 21 Bering began his homeward voyage. On August 2nd, southwest of Kodiak (Kadyak) were discovered the Island Tumannoi („Foggy"), or Ukamok, and also the Evdokeev Islands (Semidi). On the 30th of August they anchored in latitude 54°48′ N among

islands that were called after Shumagin, the first man that had died on board the „*St. Peter*“ and who was buried there. On the Shumagin Islands the Europeans met the Aleuts for the first time. Steller gave brief, but valuable information on this people. The Aleuts („Americans“) believed the Russians to be beings not of this earth and rendered them all godlike honours, which consisted in bringing them staffs decorated with falcons' feathers, bird wings and colours.

On September 24, in about latitude 51° N they discovered an island called the Island of St. John; it was Atka (Atkha), one of the Aleutian Islands. On October 25th they saw an elevated island which was named St. Markian, now Amchitka, one of the Rat Islands of the Aleutian chain.[1] The following day they discovered the Island of St. Stephen, or Kiska,[2] belonging to the same group, and on the 29th the Island of Abraham in latitude 52½° N, one of the Near Islands (Semichi). During September and October our navigators were pursued by terrible storms when at last, on the 4th of November, they saw land. This was the island which is now called Bering Island. Here, on the 8th of December 1741, Bering died from scurvy. Those that remained alive returned in 1742 to the harbour of Petropavlovsk. Steller left an excellent account of the nature of this island. He paid particular attention to the life of the arctic fox, fur seals, sea lion, sea otter and the sea cow, which were then all very plentiful in those places. Waxell made a drawing of the sea cow, which since the year 1768 has been completely exterminated.

Chirikov's Voyage. As we have mentioned above, Bering's and Chirikov's ships separated on the 20th of June, 1741 in latitude 49°. On July 15th the „*St. Paul*“ discovered land in latitude 55°31′N (Cape Addington). This was one of the small islands lying to the northwest of the Prince of Wales Islands. Here the course was changed northwards and then, in latitude 59°, westwards. On his way back, Chirikov discovered several of the Aleutian, Islands where he met with the Aleuts. On September 21, in latitude 52°36′ they saw the most western of the Aleutian Islands, Attu. On the 9th of October they anchored in the harbour of Petropavlovsk.

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[1] According to capt. Bertholf, St. Markian is Kiska.
[2] Buldir (Buldyr) according to Bertholf.

The results of Bering's expeditions in the Pacific Ocean consisted in the discovery of the Bering Strait, the northwestern coasts of America between latitudes $55^1/_2^\circ$ and 60° N, the Aleutian Islands and the Island of Bering, and also in the survey of the coasts of the Okhotsk Sea, Kamchatka, Kuril Islands and part of Japan.

Bering's expedition was a heroic enterprise of great importance. The equipment and the execution of the expedition were carried out under most unfavourable conditions. It must be remembered that all the outfit had to be transported across the whole country, from St. Petersburg to Okhotsk. The American captain E. Bertholf, who was familiar with the northeastern part of the Pacific, in his recently published paper (1922) speaks thus of this expedition: „The voyages of Bering and Chirikov are events of great importance. These two navigators crossed the Pacific and discovered the northwestern coast of the American continent at a tremendous cost and in the face of untold difficulties; and a seaman reads the details of their struggle with increasing respect and admiration for the men who achieved so great an object with tools so inadequate for the purpose".[1]

Voyages to Japan. We have now to relate the voyages of the members of Bering's expedition to the coasts of Japan. But let us first see what previous knowledge the Russians had of that country.

During his expedition to Kamchatka in the years 1697—99, Atlasov, whilst on the river Icha, found out that the Kamchadales had a captive ship-wrecked Japanese from Osaka. The poor man, through a Koryak interpreter, explained to Atlasov that he was sailing from Osaka to Tokyo, and that a heavy storm overtook him, the ship being tossed all over the sea for six months, when at last she was thrown on to the shores of Kamchatka to the south of the Bolshaya River. The Japanese, whose name was Denbey, was brought to Moscow and on January 8, 1702, presented to Peter the Great. He was the first Japanese in Russia. In January 1702, in Moscow at the Siberian Office („Sibirski Prikaz"), Denbey gave a very interesting account of his voyages to Kamchatka and Japan.

One of the principal aims of Bering's expedition was to enter into friendly intercourse with Japan. The instructions given to captain

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[1] E. Bertholf in: Bering's voyages by F. A. Golder, vol. 1st., New York, 1922, Amer. Geogr. Soc., p. 348.

Spanberg at St. Petersburg, ordered him to go with three ships „for observation and the discovery of water passages to Japan", also „to examine its lands and ports, trying at the same time to interest the Japanese in his favour, so that through friendship they might overcome their inveterate Asiatic shyness".

At that time the outlines of the Japanese coasts were very little known both in the western countries and in Russia. On the maps of that time, in the place occupied by the northern part of Japan, was shown an Island of Yezo (Hokkaido, Matsmai), to the east of it a large States Island and still further to the east a non-existing Gama Land. The States Island, or Iturup, was discovered by the Dutchman Vries in the year 1643. On the maps of the XVIIIth and the first half of the XVIIIth century reigns an extraordinary confusion with regard to the Island of Yezo: some have joined it with the continent of Asia, others connect it with America and still others mapped it as an enormous island lying between Asia and America. On the map of Strahlenberg (1730) Yezo is identified with Kamchatka („Terra Kamtszatka alias Yedzo"). The astronomer Joseph Delisle, member of the Russian Academy, in 1732, by request of the Senate, compiled a map which was handed over to Bering for guidance. On this map in lattude 48° N. to the northwest of the vast Company Land (one of the Kuril Islands seen by Vries in 1543, 45°—48°) is mapped the much discussed land of Gama, which Delisle supposed to be joined to California. It was a great merit of Bering's expedition that all these absurdities disappeared from the maps.

On May 21, 1739, Spanberg sailed from Bolsherietsk to the coasts of Japan. On June 16, in latitude 39° he sighted Nippon. Following the coast southwards, on June 22 he anchored in about the latitude 38°20′N and commenced parleys with the Japanese. There are also Japanese sources of information concerning a visit of a Russian vessel.[1]

In that same year (1739), lieutenant Walton, a subordinate of Spanberg, sailed to the shores of Japan. He landed at Hondo in latitude 35°10′N, where steersman Kazimerov and his seven men

[1] „Hokkaidoo Sikoo", part 1, 1896, p. 47—48; the extract is given by D. Pozdneev in: Documents for the history of northern Japan and its relations with the continent of Asia and with Russia (in Russian), II, Yokohama, 1909, p. 18—20. See also. L. Berg. The Discovery of Kamchatka, etc., Petrograd, 1924, p. 88—90 (see Bibliography).

went ashore. Following the coast of Japan further south, on June 23 they reached latitude 33½° N. On July 23 they returned to Bolsherietsk. This visit is also mentioned in Japanese sources.

In the year 1742, Schelting, another subordinate of Spanberg, reached latitude 50°10′ N and made the eastern coast of Sakhalin, which he calls the land of Yesso (Yezo). Sailing six miles off the shore, and not always being able to see it owing to the heavy fogs, he went further south as far as the latitude of Laperouse Strait (45°34′).

As we see, our Russian navigators made many very important geographical discoveries: they surveyed the Kuril Islands and a part of Japan, proved the land of Gama to be non-existent and showed, that the States Island and Company Land were nothing else but two of the Kuril Islands. Lastly, they were the first to discover the sea passages from the north to Japan. Based on the survey maps of Spanberg and Walton a chart was drawn and printed in the Russian Academical Atlas in 1745. It represents the mouth of the Amur, Sakhalin, part of Japan, the Kuril Islands and the southern part of Kamchatka (compare also the facsimile from the same Atlas representing a part of the general map of the Russian Empire).

Aleutian Islands. As has already been mentioned, several of the islands of the Aleutian chain were discovered by Chirikov and Bering in the year 1741 on their way back from America to Kamchatka. The remaining islands were also discovered and surveyed by the Russians.

After Chirikov and Bering, the first man to go from Kamchatka to the east was a Tobolsk peasant, Emelian Basov. In 1743 and 1744 he wintered on Bering Island, and in 1745 landed on Medny Island. In the years 1745—46 the navigators M. Nevodchikov and J. Chuprov wintered on the Near Islands. Nevodchikov drew a map of the newly discovered islands (Attu, Agattu and Semichi), which was sent to the Senate on May 4, 1751. In the years 1752 to 1754 the navigator Bashmakov visited the Andreianov Islands, and in 1757 the Rat Islands (Krysyi). In 1760—64 a merchant from Selenginsk, Adrian Tolstykh, on his ship the *„Adrian and Natalia“* made a detailed survey of the group of islands which now bear his name. The chart of the Andreianov Islands was presented to the Empress Catherine II.

In the years 1759—62 the Yarensk citizen (gvt of Vologda), Stepan Glotov, visited the islands of Umnak and Unalaska (Unalashka); on September 1, he landed on Umnak and during a long stay there became acquainted with Unalashka. He surveyed both of these islands. In the year 1761 a ship belonging to merchant Bechevin reached the peninsula of Alaska. In 1762 a ship commanded by merchant Druzhinin reached Unalashka. After Bering, the Island Kodiak (Kadyak) was discovered a second time by Stepan Glotov, who there spent the winter of 1762—63.[1]

In the year 1764 lieutenant Sind discovered and surveyed the St. Matthias Islands in the Bering Sea. In 1767 a Ustiug merchant V. Shilov presented to the Admirality a chart of the Aleutian Islands eastwards to Amlia Island. In the year 1768—69 captains Krenitsyn and Levashov[2] visited the Lissyi (Fox) Islands, Umnak, Unalashka and the western side of the peninsula of Alaska, which were surveyed and mapped.

In 1784 the Rylsk citizen G. Shelekhov settled on Kodiak. After a short time, the opposite shore of the peninsula of Alaska, the adjacent islands and Kenai Bay (Cook's Inlet) were investigated. On the shores of the latter and on Afognak fortifications were established. In the year 1787 he returned to Irkutsk and presented an account of his voyage with a map of the lands he had visited.

In June 1786 the „*St. George*", the ship of a merchant Lebedev-Lastochkin, discovered the Island of St. George, where seals were to be found in plenty. During the next year the neighbouring island of St. Paul was discovered. This group of islands is now called the Islands of Pribilov (Pribylov). In 1791 Bocharov surveyed the northern coast of the peninsula of Alaska, beginning with Isanakh Strait, which separates Unimak from Alaska, after which he travelled overland by the shortest route to the southern shore, opposite Kodiak.

We may also note the expedition of G. A. Sarychev who in 1790—92 surveyed the Aleutian Chain, the Commander Islands,

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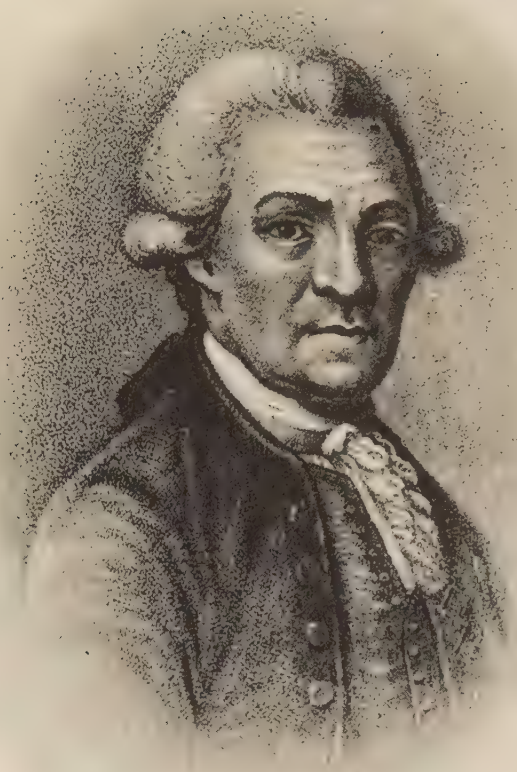
[1] Collection of papers extracted from the Calendar. Edited by the Academy of Sciences, III, 1789 p. 356., St. Petersburg; a very valuable series (see Bibliography).

[2] Neue Nordische Beyträge, X, 1781, p. 249—272 with a map Notes („Zapiski") of the Hydrographical Department (see Bibliography).



S. KRASHENINNIKOV
(born October 18, 1713, died February 25, 1755)

Pribylov Islands, St. Matthias, St. Laurence and Diomede Islands, Bering's Strait and Unalashka.

In accordance with Baranov's proposition in 1796 a Russian settlement Novorossiisk was founded on the bay of Yakutat. In 1798 the Russian-American Company was formed, the management of which was entrusted to Baranov. In 1799 a settlement was founded on Sitka, which several years later was plundered by the Tlinkits. In 1804 to replace this settlement, Novoarkhangelsk was founded on Sitka in latitude 57°3′ N. At that time there were thirteen Russian settlements between Kodiak and Sitka.

In 1812, in latitude 38°33′ N not far from San Francisco Bay, a fort called Ross (i. e. Russian) was founded at the southernmost point of the Russian possessions in America.

II

In the early days the supplies for the Russian colonies in America had with great difficulty to be transported overland through Siberia to Okhotsk. This circumstance imbued the Russians with their first impulse to circumnavigate the globe.[1] As a result of such voyages many hitherto unknown islands were discovered in the Pacific.

In the beginning of the year 1803 two ships were fitted out, the „*Nadezhda*" under the command of captain J. Krusenstern, and the „*Neva*" commanded by I. Lisianski. At the end of July 1803 the „*Nadezhda*" and the „*Neva*" sailed from Cronstadt, having, by the way, the commission of conveying to Japan the Russian ambassador Resanov, who was to establish commercial dealings with that country

On the 14th of November 1803, the Russian flag appeared for the first time in the southern hemisphere and, having doubled Cape Horn, the ships in February 1804 entered the Pacific. The „*Nadezhda*" made many surveys and astronomical observations in the group of the Marquesas Islands, which now belong to France. On July 2, the „*Nadezhda*"

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[1] As early as in 1786 an „ukaz" (order) was issued to fit out a round the world expedition, captain Mulovski being appointed its chief. But owing to the outburst of a war with Sweden and Turkey, the expedition had to be postponed; see: A. Sokolov. Notes („Zapiski") of the Hydrogr. Depart. (see Bibliography).

arrived at Petropavlovsk in Kamchatka. On the 27th of August, having repaired his ships, Krusenstern again put to sea for the purpose of conveying the ambassador to Japan. In a month's time he arrived at Nagasaki, but the legation was unsuccessful: after having kept them waiting for five months, the Japanese refused to enter into any negotiations with Russia.

After leaving Japan, Krusenstern directed his course northwards, making astronomical observations and surveying the coasts of Japan, especially that of the Island of Yezo. On May 1, 1805, he passed the Strait of La Perouse and entered the Aniva Bay on the southern coast of Sakhalin, and continuing the survey reached the Cape of Patience. From here he went back to Kamchatka. Returning on the 23rd of June to the Cape of Patience for surveying purposes, he again sailed to the northern part of Sakhalin and, after having rounded it, approached the mouth of the Amur. Finding here a strong current from the south and fresh water, Krusenstern came to the false conclusion that Sakhalin, as was also supposed by La Perouse, was connected with Asia to the south of the Amur. This error was rectified by Nevelskoi fifty years later.

In the group of the Hawaii Islands in latitude 26° N Lisianski discovered an island which was called by his name. During this voyage the first measurements of temperature in deep water were taken, astronomical observations and observations of the currents and tides were made, the specific gravity of the sea water was measured, a dictionary of the Ainu and Chukchee languages was compiled, ethnographical specimens were collected and many other researches on ethnography were carried out. In August 1806 both ships returned to Cronstadt.

In 1814 lieutenant Lazarev on the „*Suvorov*" discovered in the Pacific to the east of Samoa in latitude 13°13′ S a group of coral islands which he called Suvorov Islands.

In 1815 the famous patron of science count N. P. Romanzov (Rumyantsov) sent a scientific expedition in order to discover a passage through the Bering Strait round North America to Europe. For this purpose the brig „*Rurik*", 180 tons displacement, was built at Abo. Lieutenant O. E. Kotzebue, who had been a cadet on the „*Nadezhda*" with Krusenstern, was appointed in command.

At Copenhagen A. Chamisso, a poet and naturalist, who

discovered the alternation of generations in salps, was taken aboard. In January 1816, doubling Cape Horn, the „*Rurik*" entered the Pacific. In March 1816 Kotzebue visited Easter Island, but was inimically received by the natives who well remembered the assault of one American captain, when twelve men and ten women were carried away by force. Here a series of discoveries in the archipelago Paumotu or Low, now belonging to France, were made. The following islands were discovered and surveyed:

Romanzov I. (Tikei), on April 20, 1816, in lat. 14°57′ S, long 144°28′ W;

Spiridov I. (Takapoto), on April 21, 1816, 14° 41′ S, 144° 59′ W;

the chain of Rurik Is (Arutua), on April 23, 1816, 15° 11′— 15° 30′ S, 146° 0′ W (northeast end);

Krusenstern Is (Tikehau), on April 24, 1816, 15° 0′ S, 148° 41′ W.

Then, on May 21, 1816, in the eastern part of the Marshall Islands[1] (in the group Ratak), were discovered Kutuzov Is (Utirik) and Suvorov Is (Taka). The channel that separates them lies in lat. 11° 11′ N and long. 169° 51′ E.

During the summer, whilst the „*Rurik*" was sailing in the Bering Sea, Kotzebue mapped the Diomede Islands in the Bering Strait.

In 1817 the „*Rurik*" made another voyage among the Marshall Islands, and the following islands were discovered:

Novyi God (New Year) I. (Miadi), on January 1, 1817, lat. 10° 8′ N, long. 170° 55′ E;

Romanzov Is (Wotje, Otdia), on January 4, 1817, 9° 28′ N, 170° 16′ E;

Chichagov Is (Erikub, Tahanea), on February 7, 1817, 9° 06′ N, 170° 04′ E;

Arakcheev Is (Kaven, Angatau), on February 10, 1817, 8° 54′ N, 171° 49′ E;

De Traversay Is (Aurh), on February 23, 1817, 8° 19′ N, 171° 12′ E;

Krusenstern Is (Ailuk), on March 1, 1817, 10° 27′ N, 170° 0′ E;

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[1] They were discovered in 1788 by captain Marshall.

Heyden Is (Ligieb), on November 5, 1817, 9° 51′ N, 169° 14′ E;

To the west of the Ratak group among the same Marshall Islands is situated the large group of Ralik Islands. Kotzebue did not see them personally, but trusting to the testimony of the natives mapped them.

In the third volume of the description of Kotzebue's voyages are to be found the reports of the naturalists of the expedition, Chamisso, Eschscholtz and others. Chamisso gives us valuable accounts of his observations not only on natural history, but also on the ethnography of the natives.

In 1819 the first and as yet the only Russian Antarctic expedition was despatched. It consisted of two vessels, the „*Vostok*" and the „*Mirny*". The „*Vostok*" was under the command of captain F. Bellingshausen, who sailed earlier with Krusenstern as a midshipman on the „*Nadezhda*", and the „*Mirny*" under the command of lieutenant M. Lazarev who had previously made a voyage round the world on board the „*Suvorov*". The discoveries of Bellingshausen in the Antarctic will be related below. On March 30, 1820, the vessels arrived in Sidney and from here they sailed to Polynesia, to Paumotu Is, were they discovered the following islands:

Moller I. (Amanu), on July 8, 1820, lat. 17° 49′ S, long. 140° 40′ W;

Arakcheev I. (Angatau), on July 10, 1820, 15° 51′ S, 140° 49′ W;

Volkonsky I. (Takume), on July 12, 1820, 15° 47′ S, 142° 11′ W;

Barclay-de-Tolly I. (Raroia), on July 12, 1820, 15° 58′ S, 142° 12′ W;

Nihiru I., on July 13, 1820, 16° 22′ S, 142° 45′ W;

Ermolov I., on July 14, 1820, 16° 22′ S, 143° 06′ W;

Kutuzov I. (Makemo), on July 5, 1820, the northeastern end in lat. 16° 37′ S, long. 143° 25′ W;

Raevsky I., on July 15, 1820, 16° 43′ S, 144° 11′ W;

Osten-Sacken I. (Katiu), on July 15, 1820, 16° 29′ S, 144° 18′ W;

Chichagov I. (Tahanea), on July 16, 1820, 16° 50′ S, 144° 53′ W;

Miloradovich I. (Faaite), on July 16, 1820, 16° 47′ S, 145° 13′ W;

Wittgenstein I. (Fakarava), on July 17, 1820, 16° 21′ S, 145° 33′ W;

Greig I. (Niau), on July 18, 1820, 16° 11′ S, 146° 16′ W.

This whole island chain beginning with Arakcheev Island and extending as far as Kruseństern I. was named by Bellingshausen as the Russian Islands. All of them were discovered and described by Russian navigators, excepting the Paliser Islands which were discovered by Cook (but surveyed by Kotzebue and Bellingshausen).

Further, on July 30, 1820, in the same group of Russian Islands was discovered Lazarev I. (Matahiva), lat. 14° 56′ S, 148° 39′ W. Then:

Vostok I., on August 3, 1820, 10° 6′ S, 152° 17′ W;

Grand Duke Alexander Island, on August 8, 1820, 10° 2′ S, 161° 02′ W;

Mikhaylov I., on August 19, 1820, 21° 2′ S, 178° 40′ W;

Simonov I., on August 19, 1820, 21° 3′ S, 178° 46′ W;

The bank of Bereghis (Take Care), on August 19, 1820, 20° 45′ S, 178° 50′ W.

Lieutenant Ponafidin, captain of the „*Borodino*", discovered in 1820 Borodino Is to the east of Riu-Kiu, and also north of the Volcano Islands in lat. 30° 32′ N Ponafidin I. (St. Peter).

On July 21, 1820, captain Vasiliev discovered the island of Nunivok near the coast of Alaska.[1] In the next year this island was described during the expedition of Khromchenko.

In 1822 captain Klochkov on the brig „*Rurik*", discovered to the south of Tasmania in lat. 43° the Rurik Shoal.

In 1823 to 1826 O. E. Kotzebue made another voyage round the world on the warship „*Predpriyatie*". On board this vessel was the famous physicist Emil Lenz, who during the voyage made oceanographic investigations. He was the first to construct a water bottle, by means of which samples of water from the depths without change of temperature could be brought to the surface. Subsequently, the same principle was used by Nansen. Lenz also made observations on the specific gravity of sea water.

[1] N. Ivashintsov. Notes („Zapiski") of Hydrogr. Depart., VII, St. Petersburg, 1849, p. 112.

On March 26, 1825, Kotzebue discovered the group of Bellingshausen Islands in latitude 15° 48′ S, long. 154° 30′ W, and on October 9 of the same year, among the Marshall Islands, the group of Rimsky-Korsakov Islands in latitude 11° 31′ N, longitude 167° E, and at the same time in their vicinity the group of Eschscholtz (Bikini), in latitude 11° 40′ N, long. 165° 22′ W.

In 1826—29 captain Th. Lütke made a voyage round the world on the „*Seniavin*". Lütke (1797—1882) was one of the most renowned Russian geographers; he sailed for a long time in the north, worked much in the Russian Geogrophical Society, and was its President, as well as President of the Russian Academy of Sciences. He died after attaining a great age, in 1882. During his voyage round the world he discovered in the Caroline Archipelago several islands, between latitudes 6° 43′ and 7° 06′ N and longitudes 157½°—158° E and called them the Seniavin Group. Besides that, he mapped twenty-six groups of islands in the same archipelago, surveyed the Bonin Is and a part of Chukchan Land. The scientific staff of the „*Seniavin*" consisted of the naturalist and geologist Postels, the zoologist and botanist Mertens and ornithologist Kittlitz. They obtained very rich collections. Mertens' ethnographical observations on the natives of the Caroline Islands may be noted.

In 1829 captain Hagemeister discovered in the Ralik group (Marshall Islands) the group of Menshikov's Islands (Kwadjelinn).

In 1835 captain Schantz on board the transport „*America*" discovered, in the same group, islands called after his name (otherwise, Wottho).

III

As has been mentioned above, the expedition of Bellingshausen made discoveries in the Pacific part of the Antarctic.

On October 31, 1820, the „*Vostok*" and „*Mirny*" left Sidney. On the 16th of November they reached the Isle of Macquarie, where at that time sea-elephants were caught. On the 28th they entered the pack-ice in latitude 62° 18′ S, long. 164° 13′ E. On January 10, 1821, in latitude 68° 57′ S, long. 90° 64′ W was discovered a high island, to which the name of Peter I was given. This island is 1.280 m above sea level. On January 17 in latitude 68° 29′ S, long. 75° 40′ W a mountainous land appeared which was called „Alexander I

Land". That was the continent of Antarctica, theretofore unknown, and first discovered by the Russians. Thus, the honour of discovering the Antarctic continent belongs to Bellingshausen and Lazarev's expedition. From there, in August 1821 they returned to Cronstadt via Rio Janeiro.

Bellingshausen died in 1852, being seventy-three years old. At Cronstadt a monument is erected to his memory.

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RUSSIAN DISCOVERIES IN THE PACIFIC

REFERENCE

(Russian discoveries are shaded and numbered by Roman ciphers)

— · · — · · — 1 Voyages of Bering 1728.
— · — · — 2 „ Bering 1741
· · · · · · · · · 3 „ Chirikov 1741.
—x—x—x—x— 4 „ Krusenstern 1804—05.
ox o x o x o x o 5 „ Lisianski 1804—05.
– — — — — 6 „ Kotzebue 1816—17.
—∧—∧—∧— 7 „ Kotzebue 1824—26.
o∧o∧o∧o∧o 8 „ Bellingshausen and Lazarev 1820—21.
xxxxxxxxxxxx 9 „ Lütke 1827—29.

I. Bering Strait 1648, 1728, 1732.
II. Diomede Is 1728.
III. St. Laurence I. 1728.
IV. Kamchatka 1697—99.
V. Bering I. 1741.
VI. Pribylov Is 1786—87.
VII. Nunivok I. 1820.
VIII. Alaska Peninsula 1761.
IX. Sakhalin 1645.
X. Kuril Is 1698—1739.
XI. Aleutian Is 1741—61.
XII. Kodiak I. 1762.
XIII. Borodino Is 1820.
XIV. Ponafidin I. 1820.
XV. Lisianski I. 1805.
XVI. St. Matthias I. 1764.
XVII. Rimsky-Korsakov Is. 1825.
XVIII. Eschscholtz Is (Bikini) 1825.
XIX. Krusenstern Is. (Ailuk) 1817.
XX. Chichagov I. (Erikub) 1817.
XXI. Heyden Is (Ligieb) 1817.
XXII. Kutuzov Is (Utirik) 1816.
XXIII. Suvorov (Taka)

XXXII. Suvorov Is 1814.
XXXIII. Bellingshausen Is 1825.
XXXIV. Lazarev I. (Matahiva) 1820.
XXXV. Krusenstern Is (Tikehau) 1816.
XXXVI. Rurik Is (Arutua) 1816.
XXXVII. Spiridov I. (Takapoto) 1816.
XXXVIII. Romantzof I. (Tikei) 1816.
XXXIX. Arakcheev I. (Angatau) 1820.
XL. Volkonsky I. (Takume) 1820.
XLI. Ermolov I. 1820.
XLII. Barclay de Tolly I. (Raroia) 1820.
XLIII. Kutuzov I. (Makemo) 1820.
XLIV. Nibiru I. 1820.
XLV. Moller I. (Amanu) 1820.
XLVI. Greig I. (Niau) 1820.
XLVII. Wittgenstein I. (Fakarava) 1820.
XLVIII. Miloradovitch I. (Faaite) 1820.
XLIX. Chichagov I. (Taha-

Cartography

by V. Akhmatov

It was in the year 1639 that Russians made their first appearance on the shores of the Pacific. They were the cossack Ivan Moskvitin with twelve of his fellow-countrymen, Krasnoyarsk cossacks, who were sent by the ataman Kopylov from the Lena river with the commission of imposing a tribute in furs (the so called „yasak") upon the native tribes they might happen to meet on their way. Moskvitin, having descended the Aldan river, went up the Maya and Yudoma rivers to a ridge of high mountains; after scaling these, he came on to the sources of the Ulya river. Having there built a boat, the venturesome conqueror after a five days journey reached the shores of a great sea. After wintering there at the mouth of the Ulya, he divided his party into two, ordering one to set off for the north along the shore, whilst he himself with the other went south. The first group reached the river Taui, whilst the second, having gone as far as the river Uda and forced the Tunguses of that region to pay the yasak, returned in 1640 to Yakutsk with the news of the discovery of the Great Sea.

The rich booty and the extreme ease with which it was obtained from a helpless population induced the Siberian cossacks to continue despatching parties with the view of gradually taking possession of the country. Thus, in 1643 Poyarkov surveys the coast between the Amur and the Ulya rivers and in 1648 Semen Dezhnev accomplishes his famous expedition from the Kolyma across the Bering Strait to the mouth of the Anadyr river, acquainting the Russians with the utmost north of the Pacific Ocean.

Fifty years later Atlasov, departing from the Anadyr region, explores Kamchatka and there sets up a fort („ostrog").

Expeditions of this kind, carried out by people destitute of any scientific knowledge, could of course only supply extremely general and vague geographical notions of the countries discovered, but, nevertheless, it is worth mentioning, that the information obtained thereby afforded subject matter for the maps of Siberia of the sotnik (captain) Semen Remezov dating from the end of the XVIIth century and which gave a truer representation of the shores of the Pacific, than the contemporary maps published in Western Europe.

Since the beginning of the XVIIIth century commences a new epoch in the cartographical study of the Pacific by the Russians. Peter the Great sends there a certain number of scientifically trained persons giving them definite tasks, amongst which the chief was to answer the question: „Do Asia and America meet together?".

As a result of these proceedings new maps and descriptions begin to appear. Thus, for instance, in 1722 the geodesist Evreinov presents a chart of a part of the Kuril Islands. In 1728 Bering prepares a minute description of the shores of the Bering Sea from the Kamshatka river to Anadyr Bay, which also was surveyed by him.

In the course of his campaign Bering became convinced of the existence of a strait between Asia and America.

In 1732 the geodesist Gvozdev discovers the Diomede Islands and approaches the coasts of America.

With 1733 the „Great Northern Expedition" begins its labours under the command of Bering. The number of men engaged in it reached to about six hundred and its cost amounted to four hundred thousand roubles. It lasted ten full years. During that period the Kuril Islands, almost the entire coast of the Okhotsk Sea, the Eastern coasts of Sakhalin and Kamchatka were described and put on charts. Bering himself in 1741 reached the American coast near mount St. Elias and anchored off an island, the position of which he determined to be in latitude 59°40′ N and longitude 48°51′ to the east of Avachinsk Bay. It was apparently the island of Kayak, although his error in longitude reached eight degrees. On his way back he discovered and surveyed a series of islands to the south of Alaska and saw the mountains of the Andreyanov Island, of the Rats Islands and of the Near (Blizhny) Islands. This campaign ended fatally to Bering: he was compelled to land on an island since called after him, where he died in the ensuing winter.

Simultaneously with Bering his companion Chirikov, who had parted with him at sea, approached the American coasts in the vicinity of Sitka Island.

The reports of the companions of Bering and Chirikov on the bountiful natural resources in the newly discovered countries roused a craving for enrichment among the Siberians, and they in troops moved eastward on self-made boats. In 1759 they had attained the furthermost of the Aleutian Islands, those of Umnak and Unalashka. To ensure the occupation of the country an expedition was sent in 1768 under the command of captain Krenitsyn, which visited the islands and the adjacent parts of Alaska. Previously to that, the merchant Shilov had drawn a chart of the entire Aleutian Islands Chain and forwarded it to St. Petersburg.

These coasts, having been visited by captain Cook at the end of the seventies, induced the Russian Government to pay increased attention to that country, so as to give support to the Russian merchants, who had already settled there. In 1785 an expedition is organised under the command of Billings and Sarychev, which sets out by land for the Far East. Since 1790 the expedition proceeds to make a systematical survey of the Aleutian Chain, of the Commander and Pribylov Islands and the islands of St. Matthew, St. Laurence, Diomede and of both coasts of Bering Strait.

Meanwhile, in view of a considerable growth of the fur industry, which in the pursuit of rapid gain spread over the new territories with elementary force, so as not only to embrace the Aleutian and Kuril Islands but to extend to the North American coasts in the neighborhood of Alaska and to the adjacent isles, the Government, in order to regulate that trade, decided, on the application of the Siberian merchant Shelekhov, to establish a special Company, which should be invested with the exclusive right of fur hunting and trading on all the islands to the east of Kamchatka. This Company was founded in 1779, and Shelekhov was appointed its manager. Having established its headquarters on Kadyak, the Company to the end of the XVIIIth century extended its influence as far as the island of Sitka where was afterwards founded Novoarkhangelsk, the main port of the Russian colonies in America, and as far south as the southern islands of the Kuril Chain, where on the isle

of Urup was founded a trading settlement in view of the newly arisen commercial relations with Japan

The establishment of the „Russian-American Company" was of great importance for the cartography of the northern part of the Pacific Ocean. Its manager, Shelekhov, was an exceptional man for his time, with wide intellectual grasp and deep practical sense. He well realised how necessary for the proper organisation of maritime industries were good charts of the adjacent seas. For this purpose he engaged experienced pilots, often from the navy, who were entrusted with making topographic descriptions and soundings in places visited by them. In that way were surveyed Chugatsk Bay and the coast as far as the bay of Bering, the SW part of Kenai Bay, the entire northern coast of Alaska as far as the Kviichak river in Bristol Bay and a series of other places in the Bering Sea and on the coast line of America to the south of Alaska.

The idea suggested by Shelekhov of establishing a sea communication between the American colonies and the Baltic Sea was also very meritorious. This was accomplished only after his death in 1803, when the Company had purchased in England two vessels: the „*Nadezhda*" and „*Neva*". The Government supplied them with experienced naval crews and entrusted them to two eminent commanders Krusenstern and Lisianski. The Company loaded them with everything necessary for the colonies, thus considerably reducing its expenses on the delivery of the freight, which going by land had previously often reached its destination after 2—3 years travelling and much deteriorated owing to frequent transshipment.

Besides their main object the ships were ordered to convey an embassy to Japan and to undertake hydrographical researches on the way.

This expedition marks a new era in the cartographical investigation of the Pacific. It was followed by the expeditions of Golovnin on the sloop „*Diana*" in the years 1807—13, of Kotzebue in 1815—18, a second one of Golovnin in 1817—18, of Vasiliev and Shishmarev in 1819—20, a second one of Kotzebue in 1823—26 and, of Staniukovich and Lütke in 1826—28. The ships arriving directly from Europe, were commanded by highly experienced seamen, their staff included learned experts, who were provided with the most perfect scientific instru-

ments of the day specially purchased for that purpose. Thus, for instance, the longitudes, obtained theretofore mostly by dead reckoning, led, as we saw in the example of Bering, to enormous errors which were aggravated by a complete ignorance of the currents, involving difficulties in navigation; now longitudes were determined by the aid of chronometers. As a result, the new topographical descriptions gave good astronomical bases in reliable determinations of various points. In effecting the survey of the Japanese islands of Kiu-Siu, Tsu-Shima, Colnet, Goto and others, adjacent to Nippon and Kiu-Siu, as well as of parts of the eastern coasts of Sakhalin and of the Kuril Islands, Krusenstern, for instance, with the collaboration of the astronomer Horner, determined 105 points, the longitudes being ascertained by means of three chronometers and controlled by moon-distances. In the same way was conducted the work of subsequent expeditions, as also that of Lisianski in the survey of the group of the island of Kadyak and of Sitka Bay.

Without dwelling upon the discoveries and investigations made by these expeditions in the southern regions of the Pacific, as they are the subject of another sketch, we shall review the principal results of their work in the northern regions.

Golovnin in 1811 effects a hydrographical surveying of the southern part of the Kuril Chain from Nadezhda Strait as far as Matsmay, based on 34 points. Kotzebue in 1816 investigates the American coast to the north of the Prince of Wales Cape to almost as far north as 68° of latitude. Golovnin in 1818 determines astronomically the situation of the Commander Islands, of several of the Aleutian Islands, makes a chart of Chianit Bay in the island of Kadyak and completes the survey of Sitka Bay. Vasiliev in 1820 discovers and determines the island of Nunivok. Shishmarev completes the survey of the island of St. Laurence and Avinov surveys the north coast of Bristol Bay as also the coast from Newhamn Cape to Good News Bay. In 1827 Staniukovich on the basis of nine astronomical points surveys the northern shores of Alaska, and Lütke the shores of Asia from the East Cape to St. Cross Bay with the adjacent islands, and makes a series of determinations of important points of the coast from Avacha Bay to Chukotski Cape.

As a result of his sea voyages Lütke published his „Navigat-

ing Atlas" of 51 charts with views of the coasts and an hydrographical description of all the coasts and islands of the Bering Sea.

The Russian-American Company, utilising the materials of the above-mentioned expeditions, continued to organise on its proper account independent surveys of the coasts that entered within its sphere of activity. Thus, in the years 1817—18 the captain of the „*Kutuzov*", Hagemeister, made the survey of the Rumiantsov, or Bodega Bay on the coasts of California and determined it astronomically. In 1821 ensues a survey of the coast to the north of Good News Bay as far as the Kuskokvim river and beyond to cape Vancouver with a surveying on the way of the isle of Nunivok, followed by the discovery, surveying and sounding of a new bay that received the name of Golovnin Bay, lying east of Derby Cape, at the entrance to Norton Sound. In 1823 lieutenant Khrushchov, cruising in search of smugglers, made a survey of the western coast of Queen Charlotte Island, of Aristosable Island, of Friedrichsund, the southern part of Chatham Strait, of Cardova Bay and of Clarence Strait, with a view to which he determined seven astronomical points. The coast from mount St. Elias to St. Cross Bay, separating the isle of Sitka from the mainland, was surveyed in the years 1823—26. Norton Sound was surveyed in 1829—30. In the following years the work was mainly carried out on the southern coast of Alaska and further south along the continent embracing the adjacent islands and gulfs.

As a result of all this work Kashevarov in 1847 drew new maps of the coasts of the Eastern (Pacific) Ocean, and in 1852 Tebènkov, at the time manager of the Russian-American Company, published an „Atlas of the North Western coasts of America, of the Aleutian Islands and of some points in the Northern Pacific Ocean". The atlas is accompanied by „Hydrographic notes" in the form of a separate book, containing indications relating to astronomical points and to the materials that were taken as a basis for the preparation of the charts. The atlas, containing 39 charts perfectly compiled and executed, served as a guide for the navigation of our ships till the very end of the existence of the Russian-American Company in 1867.

With the closing of the Russian-American Company Russia's work on the American coasts ceases, and is being replaced by an intensified exploration of the eastern coasts of Asia.

J. KRUSENSTERN
(born November 6, 1770, died August 12, 1846)

True, the inadequacy of the Okhotsk harbour, that served as a base in the relations of the Company with Siberia, had previously induced it to explore the coast of the Okhotsk Sea in order to find a more convenient port, and for a time Ayan was chosen for that purpose, but still the main business of the Company was with the American coasts.

The Ayan harbour having soon proved unfit, Petropavlovsk in Kamchatka was designed to supply the need of a main naval port. (The transfer took place in 1850).

Meanwhile, in view of the uncertainty of the political position of Amurland, the military authorities of the port of Okhotsk undertook an investigation of the southeastern coasts of the Okhotsk Sea and of the mouth of the Amur. After the failure of several attempts by various persons to achieve that object, Nevelskoi in 1848 succeeded not only in discovering a fairway for entering the river, but even in proving the existence, between Sakhalin and the mainland, of a strait with the least depth of 5 fathoms (10 meters), in place of a sandy neck of land, as was asserted by previous navigators. Thus was established the connection of the Japan sea with that of Okhotsk.

In consequence of this discovery Nevelskoi is charged with making a further investigation of the country, and for that purpose a special Amur expedition is organised. By this means the coasts of the Tartar strait as far as the Imperial Harbour on the continent and the settlement of Crillon in Sakhalin are explored in methodical succession, the existing harbours ascertained, soundings in the mouth of the Amur and of its navigable waters taken. The results obtained permitted the port to be transferred to Petropavlovsk in 1855 and shelter to be provided for all the war vessels then in the Far East at Nikolaevsk on the Amur, which since the ensuing year becomes the chief town of the newly instituted Maritime or „Primorski" Province. Somewhat prior to this the vessels of the squadron of admiral Putiatin, who in 1854 had concluded a commercial treaty with Japan, effected the first survey of the eastern coast of Corea and of parts of the coasts of Sangar strait.

In 1857 Rudanovski draws the first chart of Sakhalin, and in 1858—59 Samokhvalov a map of Amurland, published by the Academy of Sciences. At the same time appears the first sailing

directions in the Tartar Strait and the estuary of the Amur with views of the most prominent points, composed by a special commission of pilots under the direction of Khalezov.

After Russia had definitively taken possession of the Amur and Ussuri regions the new dominions began to be explored. Warships navigating in those waters make surveys and take soundings in the bays and harbours of the Russian coasts of the Japan Sea, as also in other places, such as: „Nakhodka" Bay, Niagata Bay on the western coast of the island of Nippon, the west and south coasts of Toyama Gulf, Bungo Strait, the islands of Tsu-Shima and Iki, etc.

Beginning with 1862 the work of investigating our coasts of the Japan Sea assumes a more systematical character. For that purpose, experts chosen from the Corps of Navy pilots, are appointed to special vessels. Their work begins with surveying Peter the Great Bay, where the port of Vladivostok is founded, to which are referred astronomical longitudes serving as a base. In the meantime a special party explores the Amur.

An accurate survey of the coasts is supplemented by systematical boat and ship soundings performed over a vast area of the sea. To increase the accuracy of the work particular triangulations are resorted to at several points. In order to impart to the basal astronomical coast determinations, constituting the foundation of cartography, the accuracy that they had then attained in Western Europe, K. Staritski is dispatched by the Government, in 1865, on a cruise to the Pacific on the corvette „*Askold*", provided with twelve box and four pocket chronometers, a vertical circle of Repsold and an „universal", and a series of other auxiliary instruments

Working on different vessels until 1870 Staritski determined 24 basal points, comprising among others, Hakodate, Nagasaki and Yokohama; he further drew charts of the northern part of the Tartar Strait and of the southern parts of Sakhalin with La Perouse Strait. For this last work he utilized 50 sheets of a one-verst instrumental survey of the W and S coasts of Sakhalin, made by sotnik Belkin and by the topographer Pavlovich. Staritski also compiled a hydrographical surveying of the interior part of Hakodate harbour, based on triangulation and instrumental surveying and a series of other minor hydrographic works.

The vast extent, however, of the regions requiring investigation, disturbs anew the systematical character of the work, and the years 1870—1880 may be noted as a period of very animated, but desultory hydrographic work, devoid of any proper guidance. The operations were scattered over the whole coast between Corea and Cape Dezhnev, the methods of work, as also its execution, had no uniformity, the staff was frequently changed, and the work was performed sometimes singly and at other times collectively.

In Peter the Great Bay surveying and boat and ship soundings spread over an ever increasing area, the summer work being supplemented by operations on the ice; in the estuary of the Amur the work of the preceding twenty years is amplified; a fairly detailed chart of the coast of the Tartar Strait from St. Vladimir Bay to that of Plastun with maps of the bays is accomplished: a three-verst zone of the coast from Plastun Bay to that of De Castries is instrumentally surveyed; a hydrographical surveying of Oliutors Bay was executed, as also ship soundings taken in the Anadyr Bay and in Sakhalin Strait.

The extreme variety of the operations and also the rising importance of the port of Vladivostok and the increase in the tonnage and speed of vessels, involving ever growing demands on cartography, at last induced the Government in 1880 to establish an independent Survey of the Eastern Ocean, to which the task of preparing charts and maps, answering to modern requirements, were confided. At the head of this survey was appointed Stenin, who had received an academical education combined with a thorough knowledge of practical work in astronomy and geodesy acquired at the Observatory of Pulkovo.[1] Thus, in 1881 in the Eastern Ocean commences a period of work in its cartography, slow and laborious, by reason of the restricted number of the staff, but steadily, systematically performed, the most efficient contemporary methods being fully made use of. As a consequence, by the year 1897, the whole of Peter the Great Bay, as also the coast line to the south as far as the Chinese frontier, are minutely mapped and measured, while operations on the Amur estuary are on the eve of being terminated, in addition to which a new survey

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[1] Stenin retained his post at the Survey till 1887. After his death he was suceeded by Andreev, who in 1894 was replaced by Maydel.

and soundings on the Sakhalin coast commenced, being based on triangulation.

In the meantime, in view of the vast extent of the coast line, the work mentioned is supplemented by the warships navigating in the waters of the Far East continuing as formerly to investigate the coasts and the separate harbours and bays. Of the most important works of this kind may be indicated beginning with the north: ship soundings in a vast area between Cape Navarin and that of Chukotski at the entrance to the gulf of Anadyr; surveys and soundings in the Anadyr estuary or lagoon; a new survey, never attempted since 1741, of the Koryak coasts; a survey of the island of Karaga with the opposite coast and of the Commander Islands with soundings in the neighbourhood of the latter over an area of ten thousand square miles; ship soundings in Avacha Bay, and along the coastline of the Japan Sea from Cape Lesseps to Peter the Great Bay; ship soundings in the La Perouse Strait. Apart from the above, the same ships were engaged in surveying and in taking sounding along the Corean coasts from the frontier to as far as port Lazarev and Memory of Dydymov, Chekurino and Chemulpo Bays.

An intended continuation of the systematical work by the survey, reorganized in 1898 into an expedition, was not carried through because of the cession to Russia of the Kwantung Peninsula. The operations of the expedition, being now headed by M. Zhdanko, were removed to the waters of Liaodung Bay and the gulf of Corea, and were proceeded with till 1904, when material for the preparation of 22 new sea-charts had been gathered.

On the termination of the Japanese war, in 1906, the systematical work of the Hydrographical Expedition of the Pacific was resumed. It was then entrusted with the task of carrying out a hydrographical investigation of the Amur lagoon and of the entire Okhotsk Sea. In view of the high demands made in regard to the efficiency of the work to be carried out in the lagoon, it was decided to have it based on a trigonometric net extending over the coasts of the mainland and of Sakhalin, while the operations consisted in an instrumental survey, in boat soundings between points on the coasts in the line of sight and ship soundings plotted from angles to coastal objects. The vast extent of the Okhotsk Sea compelled the hydro-

graphic investigation to be carried out with the aid of a systematical running survey compiled for that purpose and based on reliable astronomical points, uniformly distributed over the coast in sufficient frequency (111 points on the whole). The bays and anchoring places were instrumentally surveyed and boat soundings were likewise taken. Ship soundings were taken while survey work was being carried out and, besides, on every cruise of the hydrographic vessel, the approaches to the most important points of the coast were investigated with particular minuteness as frequently as possible. In the period from 1906 to 1917 the expedition, in this way, succeeded in accomplishing the survey of the Amur estuary, preparing for it new exact charts of that region and a hydrographical surveying of the whole of our coastline of the Okhotsk Sea from the new frontier with Japan, and also of the eastern coast of Kamchatka to the island of Karaga incl. As a fruit of this last very extensive labour appeared the new general charts of the Okhotsk Sea on a scale of 10 miles to the inch, maps of the Kamchatka coastline, 3 miles to the inch, a series of charts and plans of separate harbours and bays and, lastly, a comprehensive Sailing Directions of this coastline, compiled and published in 1923 by the last chief of the Hydrographic Expedition, B. Davydov, who succeeded M. Zhdanko in 1913.

The Russians, having thus reached the wild and wholly unexplored northern shores of the Pacific Ocean, within a period of two hundred years accomplished a vast cartographical work. The first hundred years were utilised in visiting the bleak coasts of the Okhotsk and Bering Seas and in mapping their outlines and noting the position of the islands with no other help than the primitive and scanty methods being at the disposal of the navigators of that time. On the ground plan of these labours work of greater accuracy is developed in the first half of the following century, which led about the middle of that century to the elaboration of charts and atlases of countries extending to the American coasts as far as St. Francisco, of so precise an execution, that many regions of the globe may even now envy them.

In the second half of last century much cartographic work, having as its object the coast line of the Asiatic continent in many parts of the Japan Sea, is being executed anew, ever gaining in

accuracy, becoming more detailed, and to the end of that century and the beginning of this assuming a systematical character.

As a result of the above it may be stated, that for the greater part of our shores on the Pacific we are now in possession of charts in general quite satisfactory for the needs of navigation. The exception are the coasts of Bering Sea north of the island of Karaga, where many places are still awaiting hydrographical investigation. True, the charts of the Japan and Okhotsk Seas are far from perfect and require additions and, what may be of still greater importance, a continuous inspection on the spot, where every kind of changes may occur in the outlines of the coasts and in the depths under the influence of diverse circumstances; for, unless such precautions be taken, the best of charts will no longer faithfully represent the actual conditions of the places drawn on the chart.

In figures the present state of our Pacific cartography may be represented as follows:

In the last catalogue (1924) of the Central Hydrographic Department eighty separate charts relating to the Pacific Ocean are included. These charts may be grouped after the seas thus: 21 charts of the Japan Sea, 13 of the Tartar Strait, 24 of the Okhotsk Sea and 22 of Bering Sea. As to their character they may be divided into the groups of: 8 general charts, on a scale of from 25 to 10 miles to the inch, 15 of a transitional character, 10—4 miles to the inch, 13 for navigation on about a 3 miles'scale to the inch, and the remaining 44 maps on a scale of from 2 miles to 25 fathoms (50 m) to the inch.

In the last group some numbers relate to sheets containing several plans each, and, consequently, if they be reckoned separetely, adding to them the plans, belonging to maps on a smaller scale, a total of 127 separate places of the coast line mapped is obtained; counting them as independent maps and plans we obtain the grand total of 163 maps and charts of the Eastern Ocean. Finally, grouping the above mentioned 80 charts after the manner of their execution, they may be divided into two parts: the first, of 37 charts—consists of charts based either on the work of former years, in certain cases even so far back as the fifties of the last century, such as 3—4 charts of the Bering Sea, or on work of a later time, until the end of that century, but executed incidentally by single persons or ves-

sels. Whereas the second group, of 43 pieces, embraces the results of the work of special organisations acting systematically, such as the Survey and the Hydrographic Expedition of the Eastern Ocean. The last group continues to grow through the accession of charts newly executed and printed. Since the publication of the catalogue of the Chief Hydrographical Department, from which the above quoted figures are given, 19 new charts have been issued: 8 on a scale of 10—3 miles, and the remaining on a larger scale — from 100 fathoms (200 m) to 4 verst to the inch; the last representing 20 different places.[1]

In conclusion it remains to be said, that in addition to charts and apart from the above-mentioned sailing direction for the Okhotsk Sea, the following sailing directions are available: one of the eastern coast of Corea to the north of Fusan Bay and of Peter the Great Bay, published in 1912 with a supplement in 1918; one of the western coastline of the Japan Sea and of both coasts of the Tartar Strait, published in 1904 with a supplement in 1915 and an appendix containing brief information on the basin of the Amur, 1914; and one of the Bering Sea with the Bering Strait, published in 1909, with a supplement in 1914. These aids to navigation contain detailed descriptions of the coast line indicated, completing the data which may be obtained directly from charts.

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Geology

by A. Kryshtofovich

1. HISTORY OF EXPLORATION

The year 1639 may be considered as the era, from which begin Russian explorations of the Pacific coasts, the year when the Russian cossacks from the shores of the Okhotsk Sea first saw the Pacific Ocean. In the orders given to the chiefs of the adventurers an interest in the natural resources of the land may be subtly felt. The instruction given to Poyarkov in 1643 contains a following question: „Is silver, copper or leaden ore to be found on the Zeya river?". Accounts given by these chiefs (as Poyarkov, Atlasov) contain so valuable a kind of information about the rivers and mountains of the country that they were of great use for the „Map (Chertezh) of the Land of Siberia" composed in Tobolsk in 1667, as well as for the map of Remezov, made in Moscow in 1701.

If, however, the principal impulse of these pioneers was a spirit of adventure and a lust after furs and other riches of the countries newly discovered including the famous mammoth bone, in the various instructions given by the central authorities an eager interest in the nature of these new countries in general, as well as in the new routes leading to them is very conspicuous. Peter the Great, for instance, gives a direct order to find out the enigmatical animal to which belong „mammoth horns".

The history of the study and description of the Russian coast of the Pacific embraces two periods: during the first, all the efforts are directed from Yakutsk, as a starting point, towards the north east as far as the coast of the Okhotsk Sea, Kamchatka, Chukchaland and North America. The study of the Amur begins only from the middle

of the XIXth century; the appearance of Russians in Manchuria, however, belongs to an earlier time: Khabarov attained the Ussuri in 1651, Stepanov in 1656 reached the town of Ninguta, and the notes concerning the journeys of Russian Embassies to the Chinese Emperor relate to the XVIIth century. Some explorers reached Amurland by several years before the conclusion of the Aigun treaty, as, A. Middendorff in 1842, L. Schrenck and R. Maack (from Albazin to the mouth of the Amur) in 1855, K. Maximowicz (from the mouth of the Amur to Ust-Strielka) in 1856, and G. Radde in 1857. These scientists cannot be regarded as expert geologists, but information contributed by them of a geographical character, was of considerable importance for the further geological study of the country. Sakhalin and the adjacent coasts of the mainland never ceased to attract the attention of Russian explorers from the beginning of the XIXth century. It must be pointed out, that although the exploration of the north east of Siberia and of the adjacent parts of America began nearly 200 years ago, serious geological studies may be said to have commenced only since the expeditions of Ermann (1828—30), E. Voznesenski (1839—49), A. Middendorff (1842), Dittmar (1851—55) and Maydel. Explorations of an earlier epoch were reduced to the simple collection of different geological and mining data, being however sometimes very scrupulous and abundant (Steller, Krasheninnikov and others). The Siberian expedition of the Geographical Society (1859—63) lay the foundation of a new epoch in the history of the geological study of Eastern Asia. Since that date the exploration of the country was couducted according to the requirements of modern science.

The history of the work of numerous expeditions that were organised by Russians since the beginning of the exploration of the country cannot be dealt with in this short sketch in anything like detail. The history of geographical discoveries proper, although closely connected with the geology of the country, is related fuller by L. Berg in an other place. Here it is not so important to give a dry list of the various expeditions, as to sum up their results in the shape of a short geological sketch of the country.

The work of Russian explorers along the coasts of the Pacific is not confined within the Russian boundaries, but spreads far out of those limits: its traces may be detected on the American coast as far

as Oregon and California, Korea, Japan, China, the Philippine Islands, etc., if not even taking into consideration the countries which simply supplied materials to our geologists for their studies. But while this work on our coasts was carried out and brought to its present state only by means of Russian efforts, in other places the share of the Russians was but of a sporadical character, or was succeeded by a period of more active exploration by the countries, which acquired the lands formerly belonging to Russia (Alaska). Therefore, in giving a general sketch of the results of the geological survey of the Russian Pacific coast we will touch upon the studies of Russian geologists in foreign countries only in our historical chapter.

Since the epoch of Peter the Great towards the Pacific move numerous expeditions perfectly equipped and having as their leaders the best scientists of the time, for, it should not be forgotten that since Peter the Great the Russian government endeavoured to attract into their service the most distinguished scientists of Europe. The ornament and pride of the science of those times, Pallas, Gmelin, Steller, Krasheninnikov, Georgi resided for years in the Siberian wilderness, thousands of kilometers away from the civilized world and threw light on the nature of the country, till then quite unknown. It is true, however, that in their endeavors to reach the East, only a few attained the coast of the Pacific. Ever since the mediaeval ages the dream of attaining India by a new route took possession of the minds. Peter the Great was also occupied with the idea of discovering a North-Eastern Passage and of reaching Japan round the northern Asiatic coasts. But this eminent ruler for a long time could not find a proper executor of his ideas, and other matters did not enable him to deal with this purpose more thoroughly. Of the expeditions of Kozyrevskoi (1713), Yelchin (1716) and Luzhin with Evreinov (1720), that were sent for the description of the islands near the Asiatic coast and for discovering the North-Eastern Passage, only the last met with a certain success. But three weeks before his death, Peter sends an able navigator, commander Bering, who during his first voyage in 1728 discovers a strait between Asia and America, which, however, was formerly passed by Dezhnev. During his second voyage (1733—43) Bering, accompanied by Chirikov, reached (in 1741) the American coast (it is true, however, that a Russian, named Gvozdev, sailing from

Kamchatka, had attained that coast in 1732). The naturalist Steller, who took part in this expedition, was the first to give a description of parts of Alaska and the adjacent islands, as well as of Bering I., of the group of the Commander Islands, where the expedition passed so sad a winter. Being left by Bering in Kamchatka, Krasheninnikov, who stayed there from 1736 till 1741, gave a detailed description of the country with much information concerning the rocks of the peninsula. His book has not yet lost its value. Steller likewise gave a description of Kamchatka. In 1775 the mining expert Peter Yakovlev visited the Copper I. to prospect for copper ore; his report was published in the „Nordische Beyträge" of P. Pallas. These „Beyträge" contain much geological information concerning these distant countries. Volume IV of the work mentioned gives us some knowledge of the Kuril Is (according to the account of Antipin and his fellow travellers) as well as of Kamchatka, even of its fossil Tertiary flora.

The geological and mineralogical descriptions of the north-eastern coasts of the Pacific given by Pallas, according to the records of Krenitsyn's voyage in 1768—69 ought not be here omitted. Numerous sea voyages of Russian navigators of the end of the XVIIIth and the beginning of the XIXth centuries contributed much to our knowledge of the rocks and ores of the countries, supplied in the accounts of several naturalists, who had taken part in these expeditions.

Sower, who took part in Billing's expedition (1785—94) gave a quantity of geological information on Kamchatka and the Aleutian Islands, and Billings himself crossed the Chukchan Peninsula on foot (1791): such a journey has not been since repeated. Hause's mineralogical collection from Gizhiga in Kamchatka must be mentioned. The glorious voyage round the world of Krusenstern (1803—06) did not contribute much to geology, but those of Kotzebue (1815—18 and 1823—26) and Lütke (1826—29) have supplied more valuable materials, owing to the share taken in them by naturalists. Chamisso and Eschscholtz took part in the expedition of Kotzebue, as well as the engineer-colonel Hoffmann, who left us his „Geological observations during a journey round the world" (published in 1829). In their works we even meet with some information on the rocks and coral islands of the southern

part of the Pacific. Postels, who was attached to Lütke's expedition, gave a description of Kamchatka, Alaska, the Aleutian Is, etc. The description by Kittlitz must be noted as well.

The work of Ermann, who visited the Okhotsk coast and Kamchatka during his voyage round the world (1828—30) is considered to be of special value. And whilst Ermann was a foreigner travelling but under the auspices of the Russian Government, the following investigator, curator at the Academy of Sciences, Elias Voznesenski, who had spent 10 years (1839—49) on the coasts of the Pacific, is a true Russian man of science. During his journey he paid a visit to Kamchatka, the Aleutian Islands and some other islands in the Bering Sea, as well as to Alaska and California. The vast material, obtained by Voznesenski, lay at the foundation of Grevingk's geological notes concerning California, published (in 1847) in the „Verhandlungen der Kaiserlichen Russischen Mineralogischen Gesellschaft" and of his detailed geognostic description of the northwestern coasts of America and the adjacent islands, which was accompanied by a first geological and orographical map of considerable value and appeared in 1850. His work contains also a description of numerous fossils from Mesozoic and Tertiary strata, accompanied with a list of fossil plants.

After Voznesenski, the engineer Peter Doroshin, by comission of the Russian Government, spent five years in Alaska (1847—1852); his materials, including some Tertiary and Cretaceous fossils, were published by Göppert and Eichwald and later on by Heer.

Middendorff while working in the Far-East from 1843 till 1846 visited the Okhotsk country and Shantar Is. His geological collections were examined by Helmersen and those of fossils by Göppert and Kayserling. Subsequently, Middendorff published a summary on the geology of Siberia (1860), being the first of its kind. To him belongs the discovery of Triassic beds with *Pseudomonotis ochotica* in the Uda region. In 1861 we see Meglitski working in the Okhotsk district, and from 1851 to 1855 Dittmar, whose work has not yet lost its importance, in Kamchatka.

A new era in the exploration of our dominions on the east begins with the expedition of the never to be forgotten Fr. Schmidt which corresponds in time with the inclusion of Ussuriland into the sphere of

Russian explorations. In 1859 Schmidt begins a study of the geology of the Amur. In 1860, with his fellow travellers Glehn and Brylkin, he works in Sakhalin and in 1861 in Ussuriland. This expedition has thrown a brilliant light on the geology and the geological past of the country, theretofore entirely unknown. It afforded a quantity of material on the Jurassic, Tertiary and Cretaceous (not then recognized as such, however) flora. His expedition first outlined the distribution of Paleozoic and Mesozoic strata, thick fresh water beds with plant remains, and gave the first information on numerous coal basins. The work on the fossil flora of Sakhalin and on the Jurassic flora of the Amur, published by the celebrated Heer, was for many years the bible of paleobotanists, and the discovery of the Cretaceous fauna has poured light upon transgressions that had occurred in Amurland. The geographical investigations of Kropotkin, which partly treat of these regions, also relate to the same period.

The expedition of Schmidt may be considered the last of the series of those great expeditions of the XVIIIth and XIXth centuries that embraced, although not uninterruptedly, the whole country and had supplied material for several branches of science. Subsequently, ensues an epoch of a deeper study of certain parts of the country, succeeded by systematical geological surveying bearing either a theoretical or an applied character. Several explorations even begin to be undertaken by local specialists and of such may be mentioned the important discoveries of the Carboniferous and Triassic faunas by Margaritov near Vladivostok and of the Jurassic fauna by Yankovski on Askold I. However, the greater part of the work is being continued by expeditions sent from St. Petersburg, that were at first occasional and restricted to particular objects; later (since 1912) the entire Far East is included in a systematical plan of a geological survey of Siberia, undertaken by the Geological Committee.

Besides the desire to bring to light the geological structure of the country, one of the motives for undertaking this work, was a wish to study its auriferous regions, coal basins and ore deposits in connection with the growing animation of life on the Pacific coast and the needs of developing its industries and ways of communication. Much material for the knowledge of the auriferous regions and the country along the railways under construction both in Siberia and

later (1895) along the Amur river was supplied by the investigations carried out by separate geological parties under the general auspices of the Geological Committee. Since 1912 the Far East was included into the general plan of the geological survey of the Committee, and now, since 1920, this work is conducted not only from the centre, but by the geologists of the Far Eastern Branch of the Geological Committee established by E. Ahnert as its Director.

Let us now shortly examine this period of exploration taking separately the various regions investigated. In the Amurland mining engineer Bogoliubski worked in the Seventies and gave a sketch of its geology and mining industry, as did min. eng. Anosov. In 1895 commences the work of the geological parties along the railway under the command of min. eng. L. Batsevich, and in 1898 the investigation of its auriferous regions. The names of the geologists Yavorovski, Ahnert, Rippas, Khlaponin, Ivanov and others must here be noted; they worked until 1912. In 1910 seven parties of the Geological Committee of the „Amur Expedition" begin their work, in which, besides several of the above mentioned, Zverev, Kazanski, Voznesenski and Makerov took part. Geological maps and descriptions of the upper part of the Zeya basin, as well as of some parts of the auriferous region of Selemja, Niman and Amgun were prepared. For the purpose of establishing a connection between the basins of the Amur and the Aldan, Ahnert twice crossed the Stanovoi Ridge. The journey of Yavorovski along the Amur, his work in Little Khingan, and in the plain of the Zeya-Bureya, as well as the researches of Khlaponin on the Selemja are of considerable importance. Every year the researches along the Amur with the object of preparing a geological map on the scale of 1:420000 grow. Special purposes were intrusted to Maliavkin and Konstantov and, during the war, Rengarten, who gave new information on geological structure and fossils, as well as relating to coal, gold, iron ore, fluorite and stibnite. The Upper-Cretaceous age of the fresh water beds along the Amur and Bureya have been first ascertained by Kryshtofovich, as well as the development in the Far East of strata corresponding to the Laramie group of North America. The remains of dinosaurs were discovered in these strata and brought to the capital, where the whole skeleton of one has been reconstructed in the Museum of the Geological Committee. After

a long interruption (1916—20) the geological work on the Amur is again progressing, being conducted by the old geologist Makerov on the upper course of the Amur, Preobrazhenski in the auriferous region of Kharga and on the lower Amur, Kozlov and Arsentiev in the coal basins. In 1926 the upper Amur is again visited by Khlaponin.

The study of the recent strata, the crust of weathering and soils has since 1910, owing to the works of the pedologists Glinka, Polynov and Prokhorov been conducted with great activity.

With no less vigor has been prosecuted the study of the geology of the sea-coast. The period „after Schmidt", who laid the foundation of the geology of the Far East, until the time of D. L. Ivanov's expedition, who first established the leading features of the stratigraphy of this country, may be noted for the work of several other explorers, such as Kropotkin and Usoltsev (1864), Bogoliubski (1876), Yankovski (1881), Poliakov, Margaritov (1888) and others. The geological and mine prospecting expedition of D. Ivanov was working in the country from 1888 till 1893; his paleontological collections were published by Diener and Bittner. Ivanov was the first to discover the presence of fresh water Permian strata as characterised by a fossil flora. By his efforts was laid a foundation for the study of the Suchan and Suifong coal basins; later the Suchan coal mines were opened. He studied as well the iron deposits of Olga. M. M. Ivanov worked on the Sikhota-Alin and in the northern part of Ussuriland. Edelstein (commissioned by the Geological Society of Russia) explored the coast of the Japan Sea; while making researches in Manchuria Ahnert has done some work in this country too. The publishing of a map of useful minerals by Reutovski, embracing also the Far East in the beginning of the XXth century was a fact of great importance. From 1908 and later we see P. Wittenburg of the Academy of Sciences working in Peter the Great Bay; he has furnished a geological description of the peninsula of Muraviev-Amurski in detail and obtained valuable paleontological material. Mushketov and Maliavkin made researches in connection with the Suchan coal-mine development.

The study of the geology of South Ussuriland received a new impulse with the organisation of the Far Eastern Geological Committee. As a result of the works of Polevoy, Kryshtofovich, Kozlov,

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Preobrazhenski, Eliashevich, Gudkov, Tolmachoff and others, as well as of previous investigations of Wittenburg, is established a standard stratigraphical scale relating to the Permian, Triassic, Jurassic, Cretaceous and Tertiary strata, some of them being subdivided into minor horizons, that may be compared with the corresponding strata of the neighboring countries. It must be noted that the Geological Committee of the Far East is not only carrying on work in the country, but has endeavoured as well to establish a connection with geological surveying in the neighbouring countries, and takes part in the Annual Geological Meetings at Peking. The appeal to convene a „Pacific Geological Congress" for the purpose of organising coordinated scientific work on the coasts of the Pacific proceeded from this institution; it found a cordial response in the neighbouring countries and the present Pan-Pacific Science Congress is excellently proving the advantage of such a cooperation.

Work undertaken in Sakhalin should be considered separately. After the departure of Schmidt the island was studied by Glehn (in 1861). Owing to their work we became acquainted with the development of the Cretaceous and Tertiary strata, as well as with their fossil flora and fauna. In connection with the discovery of the coal and oil deposits in this island, work is successively carried on by Nosov (1859), Lopatin (1868), Deichmann (1869), Köppen (1885), D. Ivanov, Bacewicz (1890), Kallistov (1903) and others that have mostly contributed to the knowledge of coal deposits. Poliakov explores the country in 1884.

A new epoch is opened by a series of expeditions dispatched by the Geological Committee. Ahnert visits the island in 1907, the expedition of Tikhonovich and Polevoy is making researches (1908—10) on both coasts of the island, gathering vast material. The work is continued by Polevoy and Kryshtofovich in 1917—20 and throws new light on the geology of the island. Then follow the surveys by Polevoy in 1922, 1925 and 1926 and by Kryshtofovich in 1925. Many other geologists visit the island: Kozlov, Preobrazhenski, Mironov, Prigorovski, Kudriavtsev, Khomenko, etc. The expeditions of the Geological Committee have completely modified the former views on the geology of the island. The coal and oil regions were thoroughly studied and a table of the succession of Cretaceous and Tertiary

strata subdivided into minor series and horizons, parallelized with those of the neighbouring countries, has been worked out on a paleontological basis.

At the same time attention was not withheld from the north-eastern part of the Asiatic coast, although, as we may conclude from the following, interest in its southern parts considerably overweighs. After the surveys made by Ermann and Dittmar we must point out the work done by Maydel (1868—70) in the Anadyr and Chukchan Peninsulas, as well as the work of Sliunin in Kamchatka. The expedition of K. Bogdanovich, which investigated (in 1896 and the following years) the Okhotsk and Kamchatka regions must be considered as having given a powerful impulse to further progress. The topographical map of Kamchatka, scale 1 : 210.000, was an important contribution to science. In 1898 Bogdanovich investigates the Chukchan Peninsula, and in 1903 we see Morozewicz working in the Commander Islands. Meanwhile, Ermann, Szachno, Lagorio (1878), Yankovski and Loewinson-Lessing (1895) have contributed several data to the petrography of Kamchatka; the latter also made a description of rocks from St. Cross Bay. The year 1910 is of importance, as from it dates the well known expedition of Riabushinski. Unfortunately, the results of the researches made by its geologists Konradi and Krug were not published. A new topographical map of the whole peninsula was accomplished by Kell. In 1912—1913 Polevoy works in the Anadyr region and makes most interesting contributions to the tectonics and stratigraphy of the Cretaceous and to the Tertiary flora and fauna, as well as to the study of the gold bearing condition of this country. In 1923 Polevoy discovers the presence of oil in the Tertiary beds of the Kronoki region in Kamchatka. On the Okhotsk coasts researches were carried out by Kazanski in 1912 and 1917, and Stalnov in 1925—26.

The limits of this short article prevent the results of each expedition to be adequately dealt with. The most convincing recognition of the value of the older expeditions was the use made of their results by Eduard Suess in his famous work „The Face of the Earth", in which they were laid as a foundation of his geological treatment of Siberia. The results obtained by all the older expeditions, as well as the latest are expounded in detail in Obrutschew's „Geo-

logie von Sibirien" (in German), 1926, and still earlier, but briefly, by Borisiak, in his „Geological sketch of Siberia", 1922 (in Russian).

We shall refer later on, in our brief geological sketch of the Pacific coast of the USSR to the results of all the former work done. Let us now throw a cursory glance on some work done by the Russian geologists on the coasts of the Pacific outside the frontiers of their native land. I have already mentioned the old works of Bering's fellow-travellers, Kotzebue and others concerning the American coast.

Some geological and paleontological papers on California, Alaska and the Aleutian Is were subsequently published by Grewingk, Göppert and Heer, of whom the latter has described the collections submitted to him by the Russian governor of Alaska, Mr. Furuhjelm, while the former studied the collections of Doroshin and Voznesenski. In 1895 Szachno has published a short note on some rocks of Sitka and Edgecombe, collected in 1823—26 by the Kotzebue expedition. Since the purchase of Alaska by the United States the activity of Russian travellers had there naturally ceased. However, the country was later visited by Bogdanovich, who published a description of Nome, by Polevoy and Tolmachoff (1913) and later by Czeczott, who examined the condition of the gold industry (1914).

Much work has been done by the Russian travellers and geologists Przewalski, Potanin and Obrutschew in Mongolia and China, but it was mostly carried out in the interior provinces of Asia. Several of them have however penetrated from the interior of China into the littoral provinces. The work of Russians in Manchuria and Korea, on the other hand, deserves full attention. From the Muscovite embassies to China in the XVIIth century some records have remained concerning their journeys to Peking; some interesting information from Chinese sources was published in the works of the abbots Hyacinth and Palladius, including the volcanic activity near Mergen as long ago as in the XVIIIth century. Kropotkin and Butyrin were the only ones to cross the northern part of the Great Khingan by the way of Tsuruhaitui-Aigun (1864 and 1881). The names Visloukh, Mikhailov, Bacewicz and Aminov, in relation to the northern part of Manchuria, ought also to be mentioned. In connection with railway construction in Manchuria, an

expedition of the Russian Geographical Society was dispatched in 1896 to the northern part of that country under Ahnert, having as a supplementary aim coal prospecting. The geological work in that country is still connected with the name of Ahnert. During the years 1896—98 and in 1901, and later, in 1920—25 he undertakes investigations, according to the following routes: 1) Poltavka — Ninguta — Omoso — Hirin as far as the mouth of the Sungari; 2) Novokievskoye — North-Korea — volcano of Bei-Shan — Hirin — Hunchun — Novokievskoye; 3) Hirin — Mukden; 4) Hirin — Kwanchentze — Mukden and many other places and up to the north; 5) Dauria — Dalai-nor — Hailar—Great Khingan—Tsitsikar (1901) and in 1920—25 he travels from the river Mudan-kiang to Tsitsikar, as well as in the basins of the Mudan, the river Mulin-ho (Muren). Ahnert's paleontological materials were published by Krasser in Vienna and later by Kryshtofovich in Peking. Part of them were studied by Grabau. At the same time min. eng. Bronnikov is prospecting the coal mines of Dalai-nor, and Polevoy undertakes some explorations in the north-eastern part of Manchuria near the famous Zheltuga gold placers. Edelstein works in Manchuria along the Amur river and in the country between Mukden and Fushun. Tertiary fossil flora of Fushun and Paleozoic plants gathered by him in Yentai were published by Palibin and Zalesky. At the same time Bogdanovich has investigated the Kwan-tung Peninsula, paying attention to the submarine placers. Returning in 1920 again to his Manchurian work, Ahnert begins to generalize the results of his long studies, and is now publishing a geological map and a map of useful minerals of Northern Manchuria. The latest works of Ahnert, as well as the surveys by Japanese geologists in the southern part of his former routes prove the correctness of his former geological conclusions. Concerning Korea, beyond the itinerary of Ahnert and the materials of Komarov examined by him, we find some information in the account of Zvegintsev.

In Japan the Russians did not carry out any active geological work, having, however, with much interest travelled in that country for the purpose of comparing the features of its geological structure with those of our own, particularly the Jurassic, Cretaceous and Tertiary strata, as containing coal and oil

(Tikhonovich, Polevoy, Kryshtofovich). Yet, several paleontologists have described some interesting materials, that were given to them for that purpose by Japanese geologists. Thus, Karpinsky has described most peculiar *Characeae* (*Trochiliscus*) and remains of some remarkable fishes (*Helicopricn*). The first discoveries of palms in Japan (*Sabal nipponica* Krysht.) were described by Kryshtofovich, as well as that of a petrified trunk of a cycad from Hokkaido (*Cycadeoidea ezoana* Krysht.) and also some Tertiary flora from Honshu. Making comparisons between the geological conditions of Sakhalin and Hokkaido he came, on a paleobotanical basis, to some conclusions concerning the latter.

Regarding the islands of Oceania and the coasts of Australia we find in the records of the first Russian voyages (Krusenstern, Kotzebùe and others) information on coral islands and on the relief and rocks of the countries visited by these explorers (in the Philippines, Hawaii and Marshall Islands and others). Kittlitz's account should especially be pointed out. Yeremeiev, Chernykh and Vorobiev studied minerals of Ceylon and Java, Niplitz, Perré and Freimann have recently travelled in Australia and New Zealand and have published their reports on the auriferous regions of these countries. Backlund made a geological survey in the western part of the Argentine (1912—13), and in the south-western part of Bolivia and has published his account in Spanish.

In 1921—22 the geologist Stoyanov was carrying out geological surveying in Timor Island, and Kryshtofovich was busy studying Tertiary strata on the Philippine Islands, visiting Luzon, Mindoro, Masbate and Tikao. As a result the development of the Vigo and Malumbang series and of metamorphic schists was more accurately outlined and some new localities of the Tertiary flora and fauna were discovered. The results of his studies were alluded to in R. Dickerson's work and were partly published by himself.

2. OROGRAPHY AND GEOLOGICAL STRUCTURE OF THE FAR EAST.

On a vast space of territory from the frontiers of Mongolia to Chukchaland, where formerly the solitary Stanovoy Chain was marked on the maps, extend various mountain ranges occasionally parallel to one another, which present the result of different orogenetic movements.

Previous Russian researches laid as a foundation to the scheme of Suess, which continues to be acknowledged by such an expert in the geology of Siberia, as Obrutschew, gave Suess grounds to regard the folded country to the south east of the Siberian table-land as the „ancient vertex" of Asia, while younger folding zones ranged from this „vertex" towards the Pacific, whereas other Russian geologists, as Tetiaiev (as well as Kober, de-Launay and others consider the Siberian table-land to be the ancient stable block, the „ancient vertex" of Asia presenting an area of the most recent folding processes.

Restricting ourselves to the geomorphological regions within the limits of the Pacific basin, we will no longer refer to this question, which is as yet far from being definitely settled. It here seems to be possible to divide the whole country under consideration into two parts: 1) the Amur provinces (with Sakhalin) and 2) the extreme north-east of Siberia adjacent to the Verkhoyansk - Kolyma country. Bearing the character of a somewhat isolated land, Kamchatka may be more conveniently dealt with together with the first region, and Sakhalin with the second, though both bear many features in common, as a well expressed folding of the Neogene.

In the Amur province on the extreme west we can distinguish the latitudinal chains of the Stanovoy Range with the chains of Djagdy-Tukuringra, as its southern foot-hills. In the Stanovoy Range we observe the development of granite, less of gneiss and crystalline schist, cut by veins of porphyry; Djagdy-Tukuringra is composed of crystalline schists, gneiss and metamorphic slates with some effusive rocks on the margins. On the south we see a band of the fresh water coal bearing Jurassic, and still farther south fresh water Tertiary and Upper-Cretaceous formations of the Zeya-Bureya plain. The core of the Bureya Range in the western part of the country is composed of granite and gneiss; then crystalline schists, Paleozoic beds and portions of fresh water Jurassic strata are to be seen. Immediately beyond several ridges parallel to Little Khingan to the east extends the Urmi-Amur depression. Still farther east, between the line Amur-Ussuri and the Japan Sea lies the group of the Sikhota-Alin ridges, which consists (according to Ivanov) of a series of parallel chains, striking to the north-east, composed of granite and gneiss, whereas the depressions between the ridges contain meta-

morphic schists, sandstones, Paleozoic limestone, Triassic, Jurassic and younger strata, among which mostly fresh water strata were ascertained. Basaltic rocks are widely developed along the coast.

Sakhalin I. is characterized by two ranges with a nearly meridional trend: the higher Eastern Range (from 700 to 2000 m) and the Kamyshevy Range on the west, formed of parallel chains and divided from each other by a broad median and some minor depressions. Paleozoic strata occur on the southern part of the Eastern Range. In all the remaining part Cretaceous, Tertiary and Postpliocene strata are developed. Of magmatic rocks andesites and basalts are most common, some outcrops of nepheline syenite and diorite are observed, whereas granite is not met with.

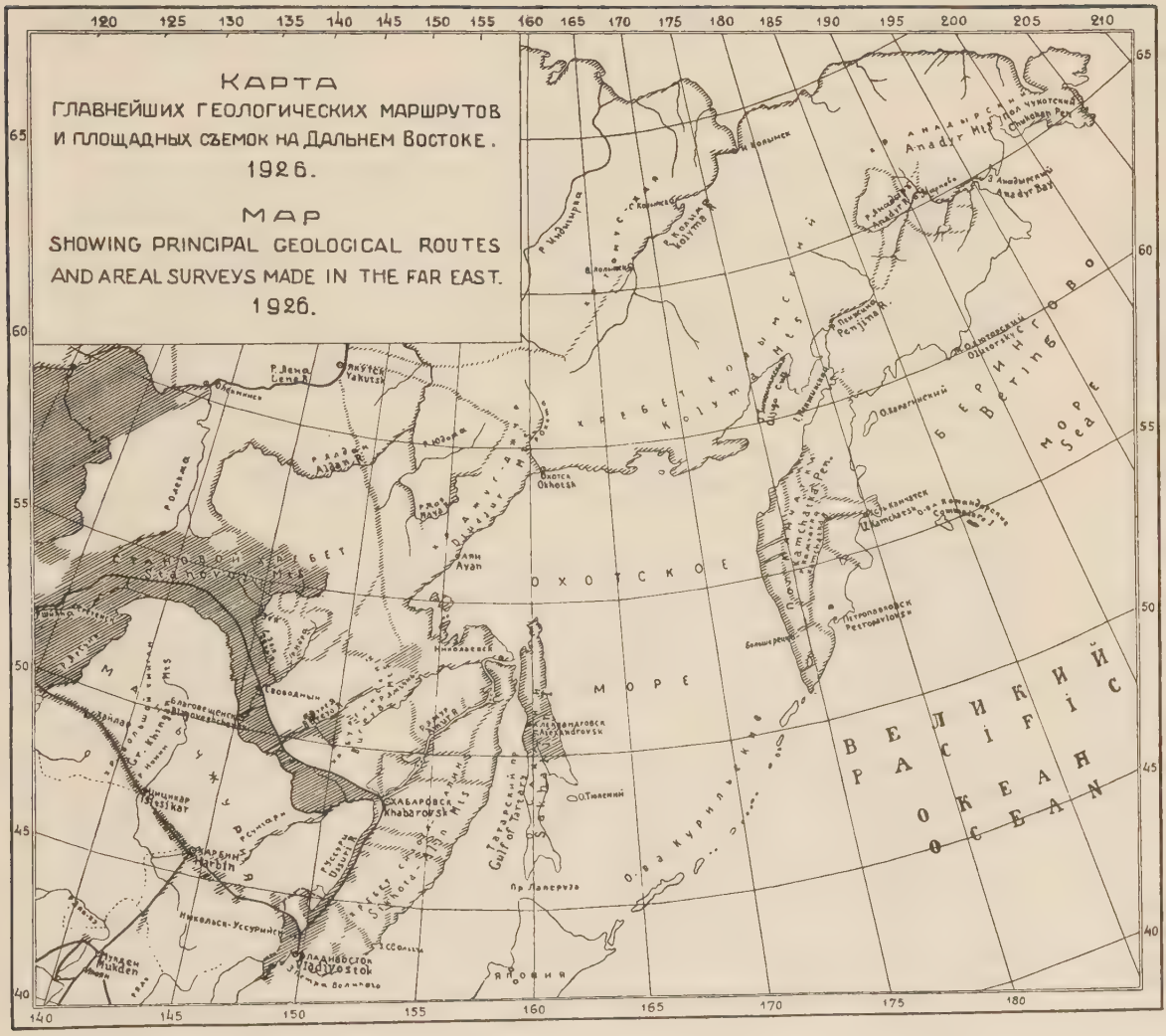
Along the coast of the Okhotsk Sea, according to the works of Maydel, Sliunin, Bogdanovich and Kazanski three mountain chains are observed: the chief watershed Djugdjur on the west, the Nemerikan Ridge being not quite clearly expressed, and the Maritime Ridge, which appears here and there, although conspicuous by its sharp outlines. This complex, ranging to the north, comes into contact with the Verkhoyansk-Kolyma arc in the district of Suntar-Khaiata. This system is characterized by a north-eastern tectonic trend and well marked disjunctive dislocations. To the older magmatic rocks of the Okhotsk coast belong those of the gabbro type, to the latest — granite, gneiss and granitite. Diabases, porphyrites and andesite represent the products of the latest effusions. Of sedimentary rocks crystalline schists of an age not quite ascertained are developed, as well as Devonian, Triassic, Jurassic, and marine and fresh water Tertiary strata (Bogdanovich, Meglitski, Middendorff, Kazanski).

Polevoy, in his work on the Anadyr region examining the scheme of E. Suess concerning the system of ridges of the extreme northern part of Asia, has considered it as being too speculative, particularly in regard to the generalized meaning of the principle of virgation to the south of the marginal garlands. Polevoy acknowledging the close connection of the ridges of the Chukchan Peninsula with Alaska, proposes to separate the extreme north-east of Asia into the following natural regions: 1) Stanovoy Range, 2) Central depression, 3) Arctic slope and 4) Kamchatka. The Kolyma Ridge with its north-eastern strike and its continuation, the Anadyr

Ridge, with an eastern trend, appear to be the extreme western members of the system. Diabase and porphyrite prevail in the Kolyma Ridge, liparite, gabbro, and granite occupy an important place in the structure of the Chukchan Peninsula. Here we observe also crystalline schists, phyllites, crystalline limestone, discovered by Bogdanovich, as well as Cretaceous and Tertiary beds. The newest dislocations accompanied by effusion of acid lavas are most characteristic.

The depression filled up by the Cretaceous and Tertiary formations, in which andesites and basalts are to be seen as well, stretches from the Penzhina and Gizhiga Bays north to the St. Cross Bay. It contains only isolated mountain groups. The ridges of the extreme northern part of the Chukchan Peninsula, that were already known to Tolmachoff and Bogdanovich, have a latitudinal and even north-western strike, ranging towards Alaska, the connection with which for the explorers, who have visited this country, raised no doubt. But latitudinal chains reach the coasts of the Ocean only on the Chukchan Peninsula: whereas on the Bering coast further to the south we observe only the meridional chains of Tingeney, Rarytkin, etc., which Polevoy considers to be the prolongation of the Kamchatka system interrupted by the Parapol depression on the north of the peninsula. These chains are characterized by a development of Cretaceous and Tertiary beds and new basaltic effusions. Finally, in the peninsula of Kamchatka after Ermann, Dittmar and Bogdanovich two ranges may be distinguished — the Eastern (known under several names — from south to north — Ganal, Valagin and Kamchik) and the Western or Central, which steeply descends to the valley of the Kamchatka river and by means of sloping terraces of the elevated tundra approaches the Okhotsk Sea. Attention should be paid to the volcanos of Kamchatka. The active ones are situated in the eastern part of the peninsula; the Kliuchevskaya Sopka (volcano) is considered to be one of the highest (4730 m). The ranges of Kamchatka are composed of granite, syenite, gneiss, crystalline schists and of some younger rocks, as Cretaceous and Tertiary strata, and basaltic and andesitic rocks.

Thus, in the whole country characterized above we cannot indicate any large plains of tectonic or erosive origin. One of the most typically repeated constant form of the relief are meridional depressions between the ridges, either composed of young sediments or still


КАРТА
ГЛАВНЕЙШИХ ГЕОЛОГИЧЕСКИХ МАРШРУТОВ
И ПЛОЩАДНЫХ СЪЕМОК НА ДАЛЬНЕМ ВОСТОКЕ.
1926.
MAP
SHOWING PRINCIPAL GEOLOGICAL ROUTES
AND AREAL SURVEYS MADE IN THE FAR EAST.
1926.
ОХОТСКОЕ МОРЕ
БЕРИНГОВО МОРЕ
Sea
ВЕЛИКИЙ ОКЕАН
Pacific Ocean
Япония
Хабаровск
Khabarovsk
Владивосток
Vladivostok
Харбин
Harbin
Якутск
Yakutsk
Охотск
Okhotsk
Петропавловск
Анадырь
Anadyr
1 : 20.000.000

being under the sea level. The largest depressions of this kind appear to be those lying to the east of the Great Khingan, Manchuria, those of the north-western coast of the Sea of Japan, Khanka Lake and the Ussuri depression; and, the depressions of the Sea of Japan, the Tartar Strait, the median Sakhalin trough, Gizhiga, Central Kamchatka and others.

3. STRATIGRAPHY

The presence of the Precambrian strata represented by gneisses, crystalline schists, etc., is established not only to the west of the watershed of the Pacific and North Polar Ocean, but also on the slope to the Pacific and in the Little Kinghan, Bureya and the Nemerikan Ridge and in Sikhota-Alin, as also possibly near Vladivostok. A part of them, however, may prove to be highly metamorphosed beds of a later origin.

In the ridges of the Chukchan Peninsula we find also some crystalline schists, that cannot be, however, referred to the Proterozoic.

On the Pacific slope of the main watershed the Cambrian beds have not been definitely found, but V. Zverev has discovered Cambrian beds on the western slope of Djugdjur in the basin of the Maya river, as a marginal zone of sediments filling up the vast Lena-Yenissei country.

The ascertained development of the Silurian with organic remains is not extensive and is confined, excepting the basin of the Aldan beyond the Djugdjur Range, to the district on the upper Amur, where Kazanski has found amid the Paleozoic group some Silurian beds: the lower series represented by sandstone with *Orthis calligramma*, the upper being slate with *Callymene blumenbachi*. They undoubtedly play a considerable rôle in the composition of the folded marginal ridges.

In the Devonian period we observe in Siberia considerable changes that affect the distribution of land and sea. On the extreme east the presence of the Devonian on the Chukchan Peninsula as a non-fossiliferous series is rather probable. Bogdanovich has discovered on the Okhotsk coast and the Ayan Bay Devonian limestone and slate up to 300 m thick characterized by Upper Devonian fauna with *Spirifer verneuili*, *S. mesocostalis*, etc.

These beds may be compared with the Chemung group. The same sediments are known in other parts of the Okhotsk coast.

In the Amur province the Devonian is widely developed to the north of the Amur, in the shape of a zone striking west-east (Makerov, Kazanski). Here in the basin of the upper part of the Amur down to Zeya the Devonian strata are most completely represented. In the space between Amasar and Oldoy we know of the presence of all the three stages of the Devonian with a rather rich fauna (Kazanski). Devonian beds are known still farther to the east, partly owing to Schmidt's discoveries on the Depp river, as well as after Ivanov and Ahnert as far as to Sikhota-Alin. Ivanov's researches in Sikhota-Alin, however, do not prove decisively the Devonian age of the beds concerned. The Devonian beds of the Pacific coast are deposited by a deep sea and lose their red colour, peculiar to them on the west. The Devonian sea was still deeper on the north-east of Siberia in the Verkhoyansk province. The Devonian sea of Amurland was in close connection with the seas of Japan and China.

On the northern Pacific coast the development of the marine Carboniferous strata is very probable, but this fact, as far as it concerns the Chukchan Peninsula, Gizhiga, Kamchatka and the Okhotsk coast is not yet proved by any paleontological data. Further on the south and west as far as Transbaikalia, these supposed Carboniferous beds are referred by some authors to the Permian. The position is particulary complicated owing to the presence here of widespread fresh water beds of the Tungusian Series, characterized by the *Noeggerathiopsis*-flora, the age of which in Western and Central Siberia is rousing acute controversy. However, some of these beds with some fauna along Gazimur in the Transbaikalia belong to the Lower Carboniferous. On the Amur owing to Kazanski the development of Carboniferous strata with fauna along the rivers Urusha, Never, Oldoi, Urka is decisively proved. Further east, Zverev considers several series as Carboniferous, as well as Ahnert, who supposes some beds along the lower part of Zeya River to be of this age.

In the eastern offshoots of the Little Khingan and near Khabarovsk we again meet with a series, that contains *Neoschwagerina* and may be equivalent to the Upper Carboniferous of Japan (or Permian). A series composed of metamorphosed slates, marmorized limestones, conglomerates, quartzites, is widely sppread on the Sikhota-Alin to

the frontier of Manchuria and contains a fauna that was considered as Upper Carboniferous, and later on as Permian (Fredericks). A part of these beds may be really older, being Carboniferous proper (Wittenburg, Fredericks). The beds near Vladivostok with Upper Paleozoic fauna are characterized by brachiopods (*Lyttonia*, etc.) and crinoids, etc., but, as it appears, beds of limestone are not so thick, and the series in a considerable degree was formed of sand and clay with admixture of volcanic products, bearing altogether the character of a shallow water formation. The *Lyttonia*-fauna seems to have penetrated from the Indian province and proves the concerned beds near Vladivostok probably to be equivalent of the Loping series developed in the central region of China.

The sedimentation in shallow water is confirmed by the transition of the marine series upwards into a well developed continental series, that is characterized by seams of coal and by impressions of fossil plants including *Noeggerathiopsis aequalis* and *Gangamopteris*.

The frequent transformation into hornstone[1] is considered to be characteristic of the series. The fresh water series is separated from the marine by sandstone with its puzzling *Spirophyton*. After Kozlov, the thickness of the Permian and the Permocarbonic beds reaches 1000 m. The fauna of these Permian deposits proves a close connection with the Indian province. Establishing the total absence of continental strata of the Carboniferous period in all the Far Eastern part of our country, we must note their probable development in Korea and Manchuria (Yentai), where *Lepidodendron oculus felis*, *Stigmaria ficoides*, etc., occur, and especially in the Chihli province of China, where the lower coal bearing series of Pensihu is most certainly purely Carboniferous.

In the Eastern and to a less extent in the Western ridge of Sakhalin are developed formations of chlorite and sericite schists and radiolarian jasper which are considered to be equivalent with the Carboniferous Chichibu series of Japan; these beds are the oldest in Sakhalin.

The Triassic may be called the most classical system of the Far East. It was discovered by Middendorff on the Okhotsk coast in the form of black shale with *Pseudomonotis ochotica*. This

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[1] Just as Norin (1925) points out for the Permian of the Shansi Province.

system being widespread in the north east of Siberia extends from the Okhotsk Sea into Yakutia. The Triassic beds, developed near Vladivostok, were discovered by Margaritov, described by Karpinsky and studied later on by Ivanov, Wittenburg, Mushketov, Maliavkin, Polevoy and others. Meanwhile, on the north the lower and upper divisions of the Triassic were represented, near Vladivostok only the lower part of the Triassic was known, as Scythian and Anysian series, with a rich fauna (*Meekoceras*, *Ussurites*, *Protoptychites* and *Pseudomonotis iwanowi*). Recently Polevoy, Eliashevich and Wittenburg have, however, established the presence of the Upper Triassic, that is developed not on the Russki Island, where lower series are so classically represented, but on the continent, as on the Muraviev-Amurski Peninsula and elsewhere. These beds contain *Pseudomonotis ochotica*, *Daonella*, *Halobia*, etc. Upwards the series, usually characterized by coarse sandstones, loses its marine character and, if the lower beds of the Mongugai series be referred to the Rhaetic, taking it as the uppermost Triassic, then it may be said even to obtain a fresh water character, foreign to the lower part of the Triassic. The coarse sandstone of the Triassic beds indicates sedimentation in a shallow sea. Few intercalations with scarce plant remains equally appear to be of marine origin. But nevertheless, on Russki Island among this scarce flora was found the most remarkable plant *Pleuromeia Sternbergii*, a last descendant of sigillarias. *Pleuromeia* was hitherto found only in Germany and Lorraine. The fauna of the Lower Triassic of Vladivostok bears an Indian character, exhibiting a close connection with Japan, and at the same time sharply differing from the boreal fauna of Olenek, although boreal elements enter into the Upper Triassic fauna.

The Jurassic strata, in its fresh water facies, containing an abundant flora, are classically represented in the Pacific part of Siberia. On the contrary, development of marine facies is yet but little ascertained and in any case is of little visible importance, except in some spots in the far north.

Some beds with *Aucella fisheri*, *A. terebratuloides* and *A. anderssoni* appear to be members of the Upper Jurassic resting in the Anadyr country (according to Polevoy) as a Volga series at the base of a thick formation, Cretaceous above. It is probable, that these strata have some connection with the beds of Byrandja south

of the Okhotsk Sea, representing the Bathonian, and in the Uda district (Meglitski, Bogdanovich), where the marine fauna with *Aucella kirgisensis* indicates the Kimmeridgian age.

Marine Jurassic beds are but little developed in Ussuriland. The presence of *Trigonia v-costata* and belemnites on Askold I. is established (Yankovski) as well as some intercalations with marine fauna (*Pecten*, *Avicula*, *Pseudomonotis*) were recorded by Wittenburg among the fresh water series. Very thick fresh water formations, partly even Cretaceous, are developed through out the whole country. They are composed of shales, loose or rather solid sandstone and conglomerate, with some coal seams (anthracite to longflamed coal) characterized by a rich fossil flora. Coal basins of this kind are met with in the upper and lower courses of the Amur, along the Bureya, Zeya, Tyrma and other rivers of the Amur system, in Sikhota-Alin, as well as on the Suchan, Suifong and in the district of Vladivostok north of the city. During many years the study of the fossil flora solely on the basis of occasionally gathered material, not having been systematical in any degree, did not allow any decisive statements on the age and geological succession of the series concerned to be made. That was the reason why the age of nearly all Siberian coal basins (formerly even including the Permian) was usually regarded as the Dogger. Collections made formerly by D. Ivanov and later by Mushketov, Maliavkin, Wittenburg and a recent detailed geological survey of some coal basins by the Geological Committee of the Far East have enabled us to state that the coal bearing strata of the Far East (and Siberia) are by no means contemporaneous. Studying the fossil flora of the Amur and of Ussuriland with the help of field observations formerly done by Eliashevich, later by Kozlov, Pavlov and Preobrazhensky, I was able to divide the whole Mesozoic coal bearing strata of Ussuriland into two main groups: 1) the Mongugai series (Lias-Raethic) with *Neocalamites Carrerei*, *Hausmannia ussuriensis*, *Clathropteris meniscioides* and *Taeniopteris stenophylla*, and 2) the Nikan series, subdivided into two divisions: a) lowermost or Lower Nikan series, containing *Onychiopsis elongata*, *Elatocladus manchurica*, *Dioonites Kotoi* with associated flora of a typical Jurassic habitus and b) Upper Nikan series, characterized by *Marchantites Yabei*, *Weichselia reticulata*, *Zamiopsis*, *Knowltonella*, *Pandanophyllum*, etc., i. e. a flora not having lost its Jurassic habitus, but

including nevertheless abundant Wealden elements and even a first Angiosperm, the most ancient found in Asia. The age of the Upper Nikan series we consider as Wealden, while that of the Lower Nikan we refer to the Upper Jurassic. As for the Amur province the typical forms either of Mongugai or of the Nikan series have not yet been found there, what leads us to the necessity of considering these formations rather as Jurassic proper, being closely related to, or somewhat older than the lower Nikan series, wherefore I give them the temporary name of the Amur series, probably containing some heterogeneous flora not yet sufficiently studied.

The entire absence of the Jurassic strata in Sakhalin is really a striking phenomenon. The Jurassic strata in the Amur and in Ussuriland are vigorously disturbed; after Eliashevich the thickness of the Jurassic in south Ussuriland attains from 3.000 to 3.750 m.

If until recently Cretaceous strata of the Far East appeared as a few separate patches, the position now has thoroughly changed. At present we have full grounds of expecting the establishment in E Siberia of a nearly complete succession of series of the Cretaceous period. These beds are mostly represented by continental facies.

On the extreme north the Cretaceous beds, discovered by Polevoy on the Anadyr river, represent strata of 1) the lower Cretaceous with *Aucella crassa*, *Polyptychites*, etc., 2) Cenomanian strata with *Stoliczkaia*, *Helioceras*, corresponding to the fauna of Utatur, and 3) Senonian sandstones with *Inocerami* overlaid with the strata which may possibly be Eocene or transitional beds with impres sions of *Woodwardites*, *Pterospermites*, *Viburnum*, *Ficus*, *Nordenskioldia*, etc. These strata, being vigorously folded, are developed also in the Tingeney and Pokulney Ranges. Exact information concerning the Cretaceous strata on the Okhotsk coast is lacking, but some indication of the presence of inocerams in this country makes their occurrence quite probable. We have some records of the Cretaceous fauna in Kamchatka. Very interesting is the question concerning of the development of marine Cretaceous beds in the Amur basin, where as it seems, after the existence of a Jurassic fresh water basin, a transgression of the sea at the end of the Jurassic period occurred which continued at the beginning of the Cretaceous in the region of the lower Amur near the Gorin river, where some black shales with *Aucella* were found, as well as on the Bureya, etc. The classical coun-

try of the development of the Cretaceous strata appears to be Sakhalin, where the system is represented by three series, called (after Kryshtofovich) the Orokkian, Gyliakian and Ainuan. Only the upper or Orokkian series exhibits rather well developed sediments of a shallow sea with the fauna of inocerams and ammonites (*Inoceramus schmidtii*, *I. lobatus*, *I. balchii*, *Pholadomya decussata*, *Helcion giganteus*, *Trigonia subovalis*, var. *minor*, *Cucullaea sachalinensis*, *Phylloceras* cf. *ramosus*, *Tetragonites*, *Pseudopachydiscus*, etc., echinoids and starfishes). The inocerams of Sakhalin are distinguished by their extremely large size. The fauna of the upper Cretaceous corresponds to the Campagnian and Mastrichtian age. A rather poor fauna has been discovered by Kryshtofovich in the Ainuan series (*Trigonia subovalis* v. *minor*, *T. pocilliformis*, *Trigonoarca*, *Callista*, etc.) that appears to be Cenomanian. The marine sediments in the Anadyr country and Sakhalin are accompanied by coal bearing strata with flora. The strata of the Nikan series in the Suifong basin give us *Weichselia*, *Pandanophyllum*, etc., which prove their lower Cretaceous age (Wealden). These beds appear to be the oldest Cretaceous sediments known throughout Siberia and probably correspond to those of Kootanie in America, being older than the strata of Kome, Greenland and the lower Potomac beds. In Sakhalin we do not meet with such a low horizons, but after very scanty ferns of the Ainuan, we come upwards to a fabulously rich flora of the Gyliakian with *Protophyllocladus*, *Pteris frigida*, *Gleichenia*, *Aralia*, *Viburnum*, *Liriodendron*, *Bauhinia*, etc., corresponding to the strata of Atane in Greenland, the upper strata of Potomac with the Dakota formation, and the Cenomanian and Turonian of Europe. These strata are covered again (on Sakhalin) by thick sandstone and black shales of the Orokkian series, still richer in dicotyledons. In the upper part occur marine horizons with inocerams. The upper beds correspond to the Senonian, not differing much in their flora from those of the Gyliakian. The lowermost Tertiary strata resting in Sakhalin on the Cretaceous, contain a flora of an absolutely different nature, which does not have a single element common to both of them. An illustration of the plant life of the epoch corresponding to the gap between the Cretaceous and Tertiary strata of Sakhalin must be looked for in Amurland, where the thick Tsagayan formation on the Bureya and Amur exhibits sediments of a fresh water basin, that contains a very rich flora with *Ficus*, *Pterospermites*, *Grewia*,

Populus cf. *arctica*, *Viburnum*, *Nordenskioldia*, as well as bones of a dinosaur, *Thespesius amurensis* Riabinin, discovered on the Amur coast. The Tsagayan formation of Amurland until its flora and fauna be completely studied, may be regarded as an equivalent of the American Laramie (s. l.) and Lance formations or somewhat lower. It must be noticed that their flora has absolutely nothing to do with the flora of the Tertiary, which is associated with the lowermost Tertiary beds of the Far East. The Far East appears to be the only country in Eastern Siberia, where Tertiary marine strata are developed, however, these beds being usually the sediments of a shallow sea and are often replaced by a continental facies. They are spread over the Anadyr region and Kamchatka (as well as on the Okhotsk coast in Sakhalin). The Neogene beds display a more continuous phase of sedimentation than the Paleogene. The Tertiary strata of Sakhalin are particulary well known; their fauna, having much in common with that of the eastern coast of the Pacific, shall play a special rôle in study of the Tertiary system of the whole North Pacific coast. A thick formation including the coal bearing Dui series, in which we observe some intercalations with *Ostrea* is resting above the basal conglomerates. Besides several other series, representing minor marine transgressions, the Loose series of Polevoy with an abundant fauna (*Thyasira bisecta*, *Pecten propatulus*, *Thracia condoni*, *Cardium decoratum*) corresponding to the Upper Miocene or Lower Pliocene, is most widely developed. These series are covered by a range of still younger horizons. Outside of Sakhalin, Anadyr, Kamchatka and the Okhotsk coast the marine strata are entirely absent. This fact proves, that the Tertiary sea did not penetrate into the country any farther, than its present boundary. Coal bearing Tertiary strata, however, are rather developed in this country and evidently correspond to the Paleogene and Neogene and represent several series (Uglovaya and Possiet in Ussuriland, and Kivda-Arkhara on the Amur). The merit of studying the Tertiary series near Vladivostok belongs to Ahnert, Eliashevich and Stempel, on the Amur — to Yavorovski, Ahnert, Konstantov, Maliavkin, etc. The general thickness of the Tertiary strata occasionally attains more than 1.000 m; in Kamchatka and Sakhalin they are rather strongly disturbed, whereas near Vladivostok their attitude is more quiet.

The Quaternary system is expressed in the Pacific zone by ma-

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rine continental sediments. The traces of marine transgression which are seen along the coast of the Arctic Ocean appear to be the oldest in the whole system. On the Chukchan Peninsula marine strata with *Astarte*, *Mya*, *Fusus* cover fresh water beds with remains of the mammoth. In the Anadyr region, according to Polevoy, a marine transgression also followed after deposition of the fresh water strata. Marine beds in Kamchatka are yet unknown, but they are represented on the Okhotsk coast and particulary in Sakhalin, attaining here 60 m. Traces of marine transgression are recorded on the continent farther south. The fresh water and glacial beds are more developed. They are usually found here on the ridges and elevated plateaus. Lacustrine and fluviatile strata occur along the Amur river in great extent, as well as in the district of Lake Khanka. Boulder clay was observed by Polevoy in the Anadyr region and by Bogdanovich on the Chukchan Peninsula. On the extreme north-east of Asia we find tundra lacustrine and fluviatile beds corresponding to the Interglacial and Postglacial age.

Magmatic rocks, that occasionally occupy large areas, are of various origin. On the extreme north-eastern Pacific slope basalts predominate; on the Chukchan Peninsula, however, we also meet with granites. Young effusive rocks (as basalt, andesite, liparite and others) are met with on the Aldan ridge, Sikhota-Alin, in Sakhalin and Kamchatka. The lavas of the present volcanos of the latter are of andesitic type. Of the intrusive rocks granite is more developed, partly being of an ancient origin, partly of Jurassic and still younger age. Nepheline syenites are known in Sakhalin side by side with rocks of a Pacific type.

Throwing a glance back on the geological history of the Pacific coast, we perceive the perpetual influence of the vast Siberian continent, that extended to the west from the marginal folded country and had exerted its powerful effect upon the evolution of the fauna and flora. The Far East has not preserved any large interior seas, like the Kaspian or the Black Sea, which could exhibit a succession of the regimes of the past by changes observed among their sediments. Former seas except those of the Paleozoic not yet perfectly known, have not very deeply invaded the stabilized continent from the east and north, leaving traces of a fauna of either boreal or Indian character.

The Pacific Ocean was always the source from which the stream of life flowed to the interior waters of the Far East. The presence of such an immense and permanent basin with a coastal line, extending from California to Indo-China through Alaska, formerly situated much more to the south, a line along which migrations of different forms took place, had no doubt an influence on the extreme uniformity of the fauna, to be observed in different parts of the Pacific coast. Moreover, this stable and vast basin was not a favourable factor for rapid change of faunas. Within the confines of the Pacific we observe a remarkable constancy, a survival *en masse* of ancient forms, in spite of Lyell's law concerning the percentage of extinct species in the Eocene, Miocene and Pliocene, based on limited material from Europe. This secular constancy or general „relictivism" is expressed the more emphatically, the more southern is the position of the country. R. Dickerson shows, for instance, how few extinct species we find already in the Miocene (or Vigo series) of the Philippine Islands, not counting the Pliocene (or Malumbang series). The same phenomenon occurs in Sakhalin and Amurland, not being however so emphatically expressed. Unfortunately, the Cretaceous and Tertiary fauna of our coasts are not sufficiently known for making definite conclusions. Most interesting therefore should be the deductions of Yokoyama, who is studying the Tertiary and Quaternary fauna of Japan, formerly dealt with in some degree by Tikhonovich. No less interesting is the process of evolution in the vegetable kingdom of the Far East. The immense everlasting land of Angarida with Serindia has played the same rôle for the flora, as the Ocean on the east for the fauna. The presence of a stable continent has enabled the vegetable types to exist until they had attained natural senility under the influence of change in the physico-geographical conditions of the earth in the chaos of orogenesis upon its crust, utrembling and overflowed with lava streams. The great Asiatic Continent was to a large extent the seat of the origin of numerous new types (not species!) of plants and in any case, it was certainly an intermediate station for these new plant-forms moving from their centres. The enigma of the Arcto-Tertiary flora, having its origin on the coasts of Greenland and Spitzbergen, may possibly find its solution on the coasts of the Pacific, for I do not doubt that here, in their successive beds, we will find the types of vegetation in their secular progress. I do

not consider it necessary to dwell on the yet little known Paleozoic flora of our Pacific coast. We know the purely Carboniferous flora from Chihli, possibly from Korea and Manchuria, with Westphalian and Stephanian types, but on the coast of Peter the Great's Bay we find only a typical Permian flora with cordaites. At the same time, peculiar *Gigantopteris* (in Korea and China) and large banana-like *Taeniopterides* are characteristic of the Permian in Shansi. But the gradual evolution of this flora in the arid conditions of the Triassic was probably soon interrupted. However, this break was not complete, for during the next period of a luxuriant plant life, after the extinction of the scanty *Pleuromeia* flora, we observe that the Raeto-Liassic flora still preserves some features of the Permian (*Neocalamites*, *Taeniopteris*). This lower Jurassic flora on the Amur and in Ussuriland was replaced by a flora, that very little differed from that of the Yorkshire coast of England (Amur series). The latter was succeded by the lower Cretaceous Nikan flora of Ussuri preserving some Jurassic features, but already containing the first angiosperms. With the greatest surprise we see the Cenomanian flora (in Sakhalin) until the end of Senonian slavishly copying the Greenland flora of the Atane strata, as well as the American flora of the Dakota beds and upper parts of Potomac, although not in such a degree. Later on it is succeeded by a broadleaved flora of the Tsagayan series of the Amur, in which we fail to recognize the common Tertiary plants, which appear later on. This vegetation in the Laramie age covered vast tracts in the United States and Canada and through the land of Beringia extended to our country. It must be noticed that the Cenomanian flora in Europe scarcely differed from the contemporaneous vegetation of Asia and America. Further on, however, comes a sharp divergence: at the time, when on the Pacific coast (from Alaska to Vladivostok, through Sakhalin) from the lower Tertiary we begin to find an Arcto-Tertiary flora, during the whole Tertiary time but little changed and very similar to the present flora of these lands, in Europe we see breaking in a peculiar flora of the Eocene and Oligocene, which has never been known to our East. But in the Miocene Europe becomes covered with a vegetation that had appeared long ago on the north and east. Thus the vegetation of the Pacific coasts bears the character of conservatism, or, better to say, of general relictivism. As best examples of this may serve the forms of *Ginkgo*, the tulip-tree, *Cercidiphyllum*, *Eucommia* and

other monotypes, often possessing vicarian forms in the America of the present time, as well as in Europe of the Miocene. It seems, that Japan has unalterably preserved its own flora since the Miocene, or, at least, the Pliocene, having lost such types, as *Comptonia, Liquidambar*. A more striking change took place on the Russian coasts, which since the Quaternary were not connected with Japan. However, towards the time of glaciation Kamchatka, Chukchaland, and the northern part of Siberia were covered by forests of an Oregon type. The spruce (*Picea Wolossowiczii, P. anadyrensis*) was preserved together with the remains of the mammoth from the timber line, and the butternut (*Juglans cinerea*) was flourishing in the Aldan basin. At nearly the same time, according to I. Hayasaka, the butternut was growing in Japan too. The rapid cooling of the climate, spread from the east of Siberia, destroyed all the more delicate forms that were being replaced by a new formation, which predominated all over the country: the Manchurian pine, larch and spruce.

Eastern Siberia represents the arena of the greatest struggle of the ancient flora with the northern newcomers, and, at the same time, of the greatest defeat ever suffered by a flora. This arena is like a battle field from which the dead are not yet removed. Stress must be laid on the fact that the Far East should be considered a land with a gradual deterioration in the climate and a development of the Siberian taiga, where with possibly some minor oscillations no period may be indicated when the former vegetation had ostensibly returned.

4. TECTONIC FEATURES

In the section on the surface morphology of the Far East a short account is given on the direction of the principal morphological elements of the surface, as a result of orogenesis. In this short sketch it is possible to add but a few more words on the tectonic movements in this country.

The general tectonic structure of any large area, moreover of a part of such a continent, as Asia, may be properly concieved, when the other principal features of its geology are fully ascertained and when its stratigraphy, petrography and orography give sufficient documents for such a reconstruction. Still, at any given moment the state of our investigations corresponds with the degree of our knowledge,

that ever seems comprehensive enough to undertake attempts to build general schemes. These attempts with regard to the geology of Asia began since Pallas. Ritter in the Stanovoy Range saw signs of internal unity, and Kropotkin, when the idea of a range, crossing Asia from Mongolia on to the Eastern Cape, was already abandoned, endeavoured to detect some genetic connection and unity in the heterogeneous ranges, constituting this belt. And even the construction of Suess, not devoid of genius, as well as a later one of de Launay, and probably, the most recent of Kober, Argand and others, are not free from speculation, the principal reasons of what appears to be an insufficiency in well established facts. Various movements of a plicative and disjunctive nature of different directions have undoubtedly created the area, which extends towards the Pacific Ocean from the country of Suess' „ancient Asiatic vertex". This latter being laid by its author as a foundation for all his constructions, has exhibited, according to the opinion of the modern school (Tetiaiev), an absence of that stability, with which it was credited. However, all the tectonic movements of our country, with the possible exception of some parts of the extreme north east, appear to be within the boundaries of the peripheral zone, the tectonic features of which are in closer connection with Pacific movements, than with those of inner Siberia, the fundamental moment of which is the Hercynian phase, that has folded the Devonian and Carboniferous strata, and eventually the Alpine.

Dislocations ranging in nearly meridional directions (to be more exact, with a NNE and NE strike) occur all over the Pacific zone. More latitudinal trends appear in the western part of Amurland, and a more northerly direction is observed to occur in the Bureya Range, which, preserving more or less its character in Sikhota-Alin, Kamchatka, Sakhalin, and, partly, Chukchaland, changes it in the latter by ranging to the NW and WNW towards Alaska.

West of our region, we observe rather energetic dislocations due to Caledonian, Hercynian and still older movements; the younger strata, however, remain undisturbed.

Traces of Caledonian foldings are to be seen in Amurland but in a few districts of Paleozoic sediments, as well as in the extreme north east. In countries, where the younger strata are vigorously folded it is rather difficult to detect the forces that

have influenced the older beds, particularly if their directions coincide.

The following moment, the Hercynian phase, is clearly observed in Amurland, where one can discern three separate zones, corresponding to the probable principal geosynclines. The first folded zone (from the west) extends along the left tributaries of the Amur as far as the Zeya, exposing considerably twisted Paleozoic strata down to the lower Carboniferous. The second geosyncline, embracing the Devonian of the Little Khingan, stretches to the Okhotsk coast. Sikhota-Alin, the Japan Sea, Tartary Strait and Sakhalin appear to constitute the third zone of the NNE — NE direction, complicated by secondary and transversal fractures. Its folding is ascribed to the Alpine phase, but here we see traces of a preceding Hercynian or Sinian one. In the region of the Okhotsk Sea along the prolongation of Penzhina and Gizhiga Bays we see a submerged geosyncline, the northern part of which already lies above sea level. A most powerful development of volcanic activity, which occurs along the principal fractures, must be here pointed out. Immense lava-fields, which may be considered to be its product, attain an area of up to 200.000 square km; as, for example, the district of Bei-shan, where besides lava sheets, an enormous accumulation of pumice and ashes, enveloping the northern parts of Manchuria and Ussuriland, may be observed. There can be no doubt, that in 1721—22 the volcanic group east of Mergen (Uyun-Kholdongir) was still active.

The extreme northern region exhibits both the newest folding, which has embraced the Cretaceous and Tertiary strata, and the oldest which has affected the Paleozoic beds, i. e. (according to P o l e v o y) traces of Alpine and Hercynian folding occur. In these parts the dominating direction of fractures and folds is NE and NNE.

5. GEOLOGICAL HISTORY

Our knowledge concerning the most ancient moments of the life of the earth's crust in the Pacific zone is very vague. It may be presumed, that in the Precambrian period a folded country occupied the present area of the Far East, which, broken into separate blocks, subsequently sunk down, being covered with new sediments and subjected in its entirety chiefly to disjunctive dislocations, while simultaneously have occurred plicative processes in the younger strata,

accompanied by erosion of the land surface. At the beginning of the Paleozoic period the greater area of the land was submerged under the waves of the Cambrian and Silurian sea, traces of which may be found in the basin of the Maya river on the western slope of Djugdjur, in the basin of the Aldan and along the upper course of the Amur, as well as at the extreme north east.

Crystalline schists of the Russki Island may be regarded as Archean, as well as Lower Paleozoic. The area of the Devonian seas is still more widely extended, having overflowed the Chukchan Peninsula, the Okhotsk coast and the central part of the Amur basin as far as Sikhota-Alin. During the following Carboniferous period the same seas (Amur, southern Ussuriland, and probably the Eastern Sakhalin Range) may still be partly observed, but the sea evidently retires and is replaced (in the Permian) by shallow seas and fresh water basins, thoroughly filled up by and with sediments, which were carried down from the newly raised heights along with tuffaceous material. Somewhere amid these beds were formed coal seams, not workable in our country, but being so in Korea and China (and in the interior of Siberia). This elevation being connected with a new folding of the lately deposited strata, as also with an energetic effusion of magma, prevented the sea from inundating eastern Siberia on a wide front, instead of which it projected into the country, in the shape of more or less deep gulfs corresponding with the pulsations of the earth's crust, subsiding in the geosynclines, while blocks sunk during disjunctive processes. Some facts obtained from the geological history of parts of Siberia situated farther west afford grounds for presuming, that no less than two phases of orogenesis occurred since the end of the Paleozoic. J. Edelstein, who has recently dealt with this subject in general, proposes to give the Precambrian phase the name of the „Baikal", and the Caledonian the name of the „Yenissei" phase, the foldings of which are locally distinguished in the northern parts of Amurland. The orogenetic phase that has produced the regression of the Carboniferous sea or the Hercynian folding Suess has connected with the formation of Altaids in that general sense, which he has attributed to that conception.

In the Triassic period, the sea, which as a narrow channel still extended from the Pacific towards the NW, likewise locally projected

into the mainland, as in the regions of Sikhota-Alin and the Okhotsk coast, ranging to the Pacific and the New-Siberian Islands towards the NW. Its sediments are hovewer of a rather shallow water character, chiefly represented by sandstones; at the following moment, at the end of the Triassic, at least near Vladivostok, may be observed the development of lakes, what may be considered to be the first phase of the formation of a large system of fresh water basins, that stands in connection with the deposition of the Upper-Angara, or as I propose to call the Mesozoic section of these continental deposits, the „Baikal" beds, containing numerous coal seams in Transbaikalia, along the Amur and Tyrma, in Ussuriland, Manchuria, etc. At the same time some marine ingressions (Askold I., Uda district and Anadyrland) have occurred from the east, when a similar powerful ingression took place from the Polar Ocean, enveloping the basin of the Lena. A distinct fauna in both shows their independence. It must be noticed, that since the end of the Palaeozoic, we are in a position to be able to make some suggestions from biological data concerning the climate that reigned in Ussuriland and Amurland. For instance, a comparison of the flora of these countries with that of China leads to the conclusion that in our latitudes it was not so luxuriant as in China. The Jurassic fresh water basins continued till the Cretaceous, and within the boundaries of Ussuriland they, possibly, had attained at that time, as well as in Japan, their maximum of development. At the same time to the end of the Lower Cretaceous may be observed the growth of tectonic movements as well as an increase in volcanic activity, when huge masses of volcanic material were piled up (tuffogenous beds of the Suifong basin). As it seems, the whole country of Sikhota-Alin, Manchuria and the Okhotsk coast was given over to the mercy of Pluto, and behind the smoke of volcanos, as behind the curtain of a theatre, a change of scenery took place: in place of the flora of a Mesozoic type appeared a Cenozoic vegetation, including angiosperms, while in its fauna the Mesozoic was reaching its end, being represented by a highly specialised branch of dinosaurs on land and equally remarkable forms in the sea depths (giant inocerams). In the Lower Cretaceous age the sea did not entirely leave our boundaries. It still remained in the Amur estuary and in Anadyrland. Towards the end of the Cretaceous period another change had taken place: with the new period of folding reappear some

large fresh water basins, at first in Sakhalin, and later on in Amurland (Tsagayan strata). The latter appear to be contemporaneous with the Laramie basin of America and have preserved a broad-leaved flora, which took possession of the ground instead of extinct ferns, cycads and conifers. Already in the Senonian a new transgression occurs in Sakhalin (in Japan on Hokkaido it takes place much earlier), as well as on the Okhotsk Sea, in Tingenei, in Anadyrland, possibly in Kamchatka, but not for long, as in Sakhalin it is again temporarily replaced by a fresh-water basin and somewhat later the Tsagayan strata on the Amur are being deposited simultaneously with a break in Sakhalin. At the same time on the borders of the present continent of Asia we can observe symptoms of stability, and, if this cannot be said of the region of the most extreme eastern folds, still partly submerged, the strata of the Amur and Ussuri, more recent than the Lower Cretaceous, appear to be comparatively quiescent. Cretaceous seas were the last to project deeply into the continent. Since the beginning of the Tertiary period an exclusively continental regime may be observed to have occurred with the exception of the margins of the trough, such as the Japan Sea and the Tartary Strait, that were however formed later. Some new seas could be traced only in Sakhalin, on the Okhotsk coast, in Kamchatka and Anadyrland in the shape of the most recent geosyncline, the submerged parts of which subsequently produced the Sea of Japan, Gizhiga and Penzhina Bays, the Tartary Strait, etc.

In the region of this syncline the sea, since the Eocene, several times bursts into the land and remains there for a comparatively long time during the Miocene-Pliocene age, being, however, not very deep. This is the epoch of oil formation. On the contrary, the vast fresh water basins produce abundant resources of brown coal (Kivda, Arkhara, Uglovaya, possibly Korff Bay and Ugolnaya Bay). However, approximatly in the Oligocene, a new orogenic movement has taken place, accompanied by powerful volcanic activity, resulting in the accumulation of abundant volcanic material and effusions of various character. The mobile part of the crust appears to be in a state of pulsation and the succeeding geological strata were deposited unconformably. However, in Amurland and near Vladivostok the Tertiary fresh water sediments are but little deflected from the horizontal position in contrast to the extreme north-east

and Sakhalin, where the beds are strongly disturbed. These movements are continuing in Sakhalin to the present time, as the Postpliocene is raised here to a height of 150 m. The lifting of the eastern coast is still continuing. Early in the Tertiary the coasts of the Pacific were clothed with an Arcto-Tertiary flora containing the chestnut, oak, beech, maple, walnut, etc. (*Castanea, Fagus, Quercus, Acer, Juglans, Trapa, Comptonia,* etc.), being closely allied with the Kenai flora of Alaska. The sea fauna still preserved its subtropical character till the Miocene and only later has shown some signs of cooling in the Pliocene. From this time we see the gradually growing influence of cooling or of migration of the geographical coordinates, as a reason of the former; the face of the continent, as well as its population, began to approach its present status. The forest flora was driven to the south (to China and Japan) and was replaced first by coniferous woods of the American (Oregon) type, which were moving from the Far East mixed with some deciduous trees. Time passes, and during the Quaternary period, this formation is in its turn replaced by a vegetation of a severer type: the larch, cedar pine, spruce and fir with a few still surviving deciduous trees (different *Acer, Phellodendron, Actinidia, Araliaceae*) remaining as a token of the Past. Only the Ocean with its cold depths in a slighter degree reacts to this change in the régime.

The question of the glaciation of Siberia is far from being settled. There can be no doubt of anything in the shape of a continuous ice cap, like the one that had enveloped Europe and America, having occurred here. It is quite possible that a moist, but rather warm climate accompanied with glaciation of separate massifs took possession of the country at the time of the Ice Age. This fact may account for alder shrubs being found in situ, under the fossil ice of the New-Siberian Islands, where the alder does no longer grow but, undoubtedly, grew in the time of glaciation, till it was buried under the margin of a glacier. On the Stanovoy range in the Anadyr country Polevoy could not observe any symptoms of glaciation, but they seem to be very prominent in Anadyr Bay, where glacial strata are deposited alternately with those of the sea transgression. The epoch of the glaciation of the Far East is not quite ascertained. According to Bogdanovich, glaciation of the Chukchan Peninsula did not coincide with that of Europe or America, but occurred somewhat

later. Is not this circumstance connected with the presence of corals in the Quaternary strata of Japan? Might not prof. Yokoyama be right in declaring, that at the time, when the glaciers enveloped Europe and America, the Land of the Rising Sun was blooming under its hot beams? One more sea ingression occurs in the Postpliocene, with *Astarte borealis*, found on the Chukchan Peninsula, on the Anadyr and in Sakhalin, the strata of which is raised to 150 m. Volcanic activity gradually dies away in different parts of our Pacific zone: in Ussuriland lava sheets sometimes over 300 m thick cover the Tertiary strata. The Bei-shan was still active in recent times, the volcanic group near Mergen having had its last eruption in 1721—22. Now all seems to rest in peace. But the numerous volcanos of the Kamchatka and Kuril arc continue to smoke and cast out their ejections. Watching their smoke, we must remember, that the cycles of geological life in the Far East are far from being over.

6. USEFUL MINERALS

Deposits of the principal useful minerals of the Pacific coast, with the exception of some of less importance, such as sulphur, clay, etc., may be divided into two groups: to the first belong metallic ores that have taken their origin from the effects of magma emanation upon the earth's crust during the orogenic processes. To the second we refer coal and oil, that have been formed in connection with the lifting and sinking of parts of the land surface and the filling of the depressions with sediments, accompanied by subordinate beds with fuel deposits, subsequently subjected to the most beneficial influences of pressure, warmth, etc.

As the magmatic processes were much more strikingly expressed in the region of folded mountain chains, embracing from the south, south-east and east the Siberian tableland and attaining the Okhotsk and Bering coasts, this zone, called the Siberian ore zone, was the birthplace of different metals (gold, silver, lead, zinc, tin, copper, wolfram, molybdenum, manganese, arsenic, etc.). The time of their origin is referred to the Paleozoic or somewhat later, as the influence of magma on the Paleozoic strata (for example, on the Carboniferous limestone) may be observed. Cases are known, when the Mesozoic and even Tertiary acid magmas exerted an enriching effect (Okhotsk coast). On the other hand, ore accumulation had already

occurred in the Tertiary beds under the direct influence of exogenic processes (spherosiderite, limonite).

In contrast to the above, J. Edelstein has shown that coal and oil strata are usually deposited at a distance from these manifestations of magmatic processes, along the marginal part of the ore zone, above the submerged blocks, where the positive and negative motion of strata and their working were of the greatest effect.

Gold, which has been worked since ancient times in Ussuriland, and is distributed throughout the country and least of all in Kamchatka, is connected with the action of granite magma on the metamorphic schists. However, it must be admitted, that the auriferous regions have in part another origin, which is also connected with magmatic processes.

Other deposits, for example, those of Okhotsk and Anadyrland, are connected with liparites (the Belaya Gora, Chlia, Orel). The gold of Amurland appears to be closely connected with the zone of gneiss schists; that country contains over 15 auriferous regions (the principal are: Upper Amur, Zeya, Niman, Selemja, Lake district, etc.), The gold reserve of the whole region under discussion is estimated to be 4.400.000 kgr. In the 1924—1925 financial year the general registered production was 945, 1286 kgr.

The extensive development of fresh water Jurassic, Cretaceous and Tertiary strata makes the Pacific coast one of the richest in *coal.* The active orogenetic movements have transformed the original substance of coal, even very recent, into bituminous coal of high grade, frequently coking coal and even antracite (Sakhalin, Suchan). On the north coal is known in Anadyrland, down to the south on the coast as far as Kamchatka, in Kamchatka itself, on the Okhotsk coast, in Sakhalin, on Sikhota-Alin and in Ussuriland. The resources of Sakhalin, according to Polevoy, are not less than 2,5 billion tons, of which the western coal field 200 km long contains 1,5 hundred thousand million tons. The best coal of the Maritime Province, where its fairly developed coal industry enables it to do without foreign coal, is considered to be that of Suchan. The most extensive basin of the Maritime Province is that of Suifong; considerable reserves of brown coals are found in the Uglovaya district. The coal resources of the Maritime Province and Sakhalin have great opportunities in the future. The

production of the year 1924—25 in the Far East was 250.000 tons of coal and 400.400 tons of brown coal.

The conditions in the deposition of *oil* within our boundaries closely resemble those of the Pacific coasts in general, oil occurring in Kamchatka and Sakhalin in the lower part of the Pliocene and upper part of the Miocene. With the exception of the eastern oil fields of Sakhalin known since long, and extending to about 350 km in length, the presence of oil was established lately (1925) by Kryshtofovich on the western coast, on the Langri river. Seepage of oil, discovered by Polevoy (1923) on the Bogachevka River, being the first in Kamchatka, gives us a hope that possibly still other deposits will be found in our Pacific dominions in connection with the wide development of Tertiary strata. The production of oil in Sakhalin in 1924 (Japanese concessions) was 12.170 tons.

We know but little concerning the *iron-ores* of Kamchatka, and nothing of the northern districts; in Amurland they occur as hematite, magnetite, spherosiderite and limonite. One of the possibly most important districts appears to be that of Olga (magnetite) on the coast of the Japan Sea, as well as the hematite deposits in Little Khingan, among metamorphic schists and hornstone and quartzite. Magnetites were formed by the action of granite on Paleozoic limestone.

Copper ores are likewise known, and among them a deposit mentioned by Bering on Copper Island, where the native copper, filling up the cavities in basalt, according to researches made by the Geological Committee, has no economical value. Traces of a similar enrichment are to be seen in Sakhalin. Signs of copper are to be found in Kamchatka and Ussuriland (Djigit Bay), but they have not yet attracted any attention.

On a level with the importance of gold, coal and oil in this country may be regarded numerous tin-silver-zinc ore deposits. The principal one appears to be that of Tetiuhe with prospected resources of about 2 mil. tons. The Tetiuhe Co. has recently resumed work in the mine. The deposits owe its existence to the contact of porphyry with limestone. Similar deposits with some modifications are known in the extreme north, beginning with Cape Serdtse-Kamen.

This sketch is too short to allude with any detail to some other

useful minerals that have not been developed. We can only briefly point out some of them: graphite is known in Chukchaland, in the Maritime province and Amurland. Near the Kamchatka volcanos sulphur occurs. In Amurland stibnite and fluorite are known. There are besides some indications of other minerals, such as manganese (near Olga), wolframite (Kharga), molybdenum (Plastun, Bodisko) and mica. Lastly, in the Kamchatka volcanic country, as well as in Amurland, numerous mineral springs of considerable importance (Annenski spring, Kuldur, etc.) occur.

If the majority of these deposits are not distinguished by any peculiarities from those of Europe and America, we cannot say the same of coals. In spite of their younger age (down from Tertiary) they contain all gradations, from anthracite and coking coal of a high grade from Sakhalin and Suchan to the longflamed coals of Suifong and Sakhalin, and, finally, to the brown coal and lignite from the environs of Vladivostok, Possiet, etc.

Such peculiarities relating to coals differing from conditions prevalent in Europe, appear to be in perfect conformity with the natural conditions of the Far East and are in obvious connection with the incidence of recent energetic movements of the earth's crust. Where these movements were not so well expressed (Amur), the coal has remained on a lower level of development. The same state may be observed to prevail in the numerous coal deposits of Japan, where the best coking Takashima coal is not older than the Paleogene.

SUMMARY

The above is but a mere sketch of the geology of the Far East and yet, although its gaps may sometimes be very great, certain of the larger features are clear in their broader outlines.

We can easily discern some features that are common to the whole Pacific and some that are sharply distinct from those of other countries. The following concluding remarks chiefly concerning stratigraphy could be written after combining all the facts mentioned above.

1. A study of the Pacific paleontology and stratigraphy exhibits a kind of conservatism peculiar to its fauna and flora, which becomes especially noticeable since the beginning of the Tertiary.

2. Certain peculiarities of local faunas and floras at each period of the past, depending upon not only geographical position, but the degree of geographical isolation to which the countries studied are subject, should be noted. The determination of the position of the geographical coordinates and of the climatic zones of the Far East in the past needs further examination.

3. The true bathrological position of most geological formations in the Far East cannot be considered as finally established. Thus, the age of the *Lyttonia* and *Noeggerathiopsis* beds is uncertain, as its determination has been based on the fauna of the Salt Range formations and the flora of the Gondwana and Kuznetsk coal bearing series, the age of which is still open to doubt.

4. The age of the Mesozoic division of the Angara strata of Siberia and the Far East, or of the Baikal division of the Angara group, is not adequately ascertained in view of a lack both of well studied profiles, embracing a successive series representing sufficiently long intervals of the past, as also of an exact characteristic of different basins distributed in various latitudes and differing in their geological history. The relation of the fresh water to the marine sediments has not been adequately ascertained.

5. The widespread opinion as to the complete uniformity of the Jurassic flora on the Earth is in a great measure due to the artificial combination into one whole of formations of varying age and different climatic zones; on the other hand, this error leads of necessity to a constantly growing inclination to assign to this geological complex all newly discovered formations possessing but some common features with certain members of this artificial assembly, which, in effect, is completely heterogeneous.

6. In Ussuriland, Sakhalin and Amurland is represented a succession of Mesozoic fresh water sediments consecutively embracing all epochs from the Rhaetic to the base of the Tertiary (and upwards), which were separated into the Mongugay, Amur, lower and upper Nikan, Ainuan, Giliakian, Orokkian and Tsagayan formations and groups, corresponding in particular to the Jurassic, Kootanie, Potomac, Dakota and the Laramie formations of North-America.

7. Owing to the conservatism of the faunas and floras, it is sometimes all but impossible not only to segregate the different stages of the Tertiary, but even to separate the Paleogene from the Neogene,

as well as to dismember the Paleogene. It is thus most desirable to make a very careful study of the Tertiary faunas and floras wherever the bathrological succession is well ascertained.

8. Ussuriland may be noted for the occurrence in its Nikan series of one of the most ancient Angiosperms: the *Pandanophyllum* sp.

9. Owing to the above-mentioned peculiarities of the Pacific geology and inability to institute a true parallelism between its formations and those of Europe and America, it becomes absolutely necessary to establish local geological scales applicable to restricted natural regions, which can with certainty be asserted to belong to the same climatic provinces of the past.

10. The next step would be to compare separate geological sections of the countries under discussion both with each other and with those of more distant parts of the Pacific, such as China, Japan, and America, and eventually to arrange them in the order of the general geological scale.

11. Owing to the wide development on the Pacific of fresh water sediments (containing important coal basins), it would be necessary to put the fossil flora on an equality with the fauna as bases for stratigraphy.

12. In order to establish the closest possible intercourse between specialists of all countries interested in Pacific geology to the end of solving the most important problems of that branch of study, it would be necessary: a) to establish a central periodical devoted exclusively to general problems in Pacific geology for the publication of short original papers of general interest, summaries, abstracts and complete bibliographies of the subject; b) to establish personal relations between geologists of the Pacific by means of common excursions, supported by the Governments concerned, and by means of periodical meetings in the shape of a further development of the Pacific movement; c) to take measures for the international solution of certain geological problems, by means of combined systematical researches with the adoption of an unitary nomenclature and the publication of maps and tables; d) to render obligatory the publication of summaries of papers written in languages using a non-Roman alphabet (Chinese, Japanese, Russian) in English, French or German. English should perhaps be given preference, as being the most desirable language for that purpose at the present time.

The proper execution of further geological, chiefly stratigraphical and paleontological, work on the Pacific on the proposed basis will alone enable us to reconstruct the edifice of Pacific geology, as majestic, as is magnificent the scale on which operate the phenomena of Nature on the greatest ocean of the world, the direct successor of ancient Panthalassa, as also on its greatest continent, whose share in the formation of organisms is as yet far from being clearly ascertained.

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(More complete lists of literature concerning the region are to be found in the works of Obrutschew, Polevoy and Wittenburg).

Seismology

by P. Nikiforov

The Russian explorers of the Pacific Ocean naturally gave their attention to the manifestations of the menacing seismic activity of the Earth's crust.

The members of Bering's expedition, the student Krasheninnikov and Steller, member of the Academy of Sciences, described a number of earthquakes in Kamchatka, the Kuril and Bering Islands, of which they were ocular witnesses (1737—1742). Data mainly referring to Aleutian earthquakes were collected by I. Veniaminov (Metropolitan Innocent); they date back to 1690. To these names may be added those of admiral Sarychev (1790—92), Khvostov (1802), J. F. Krusenstern (1803—06), Shabelski (1821—23), captain O. Kotzebue and his companions Hoffmann and E. Lenz (1824), commander Th. Lütke and his companions Postels and Mertens (1826—29).

The above-mentioned explorers, as well as a number of others, not mentioned here, collected fairly numerous data illustrating the seismic conditions of the islands and Pacific coasts belonging, or having once belonged to Russia.

True, these data are far from being complete; they refer to detached periods of time, in the majority of cases corresponding with the visits of various scientific expeditions to our far possessions on the Pacific coasts, and to occasional points of territory, in consequence of what no distinct idea of the area of expansion of each earthquake could be obtained.

Nevertheless, from the above data we learn of 67 earthquakes, which have occurred in Kamchatka from 1737 to 1888; of 16 earthquakes in the Kuril Islands, for the same period; of 9 on the Okhotsk

coast, from 1781 to 1888; of 39 earthquakes in the Aleutian Islands from 1788 to 1888; of 9 in the Commander Islands, from 1742 to 1888; of 2 in the Pribylov Islands, from 1835 to 1888, and of 3 earthquakes in Sitka Island, from 1843 to 1888. For want of space we omit details on these 145 earthquakes,[1] yet we cannot desist from mentioning the terrible earthquake of October 17, 1737, which spread over the eastern side of Kamchatka and the northern Kuril Islands. According to Krasheninnikov, during that earthquake a tidal wave arose, 30 fathoms high in the vicinity of Petropavlovsk and the sea cliffs on the sea coast split asunder; mountainous rocks from the sea bottom in the strait between the first and the second Kuril Islands, never seen before, were disclosed, though „quakes and inundations had previously occurred". The relief of the earth's surface was subject to considerable disturbances: „at some places meadows turned to hills; at others, fields were transformed into bays". It is remarkable that at the western side of the peninsula, at Bolsherietsk, only slight movements of the soil were perceptible at that time and no damage occasioned.

Considerable earthquakes subsequently occurred in Kamchatka in 1742, 1756, 1791, 1792, 1904 and finally on the 30th of January 1917. At the latter date Russia possessed a properly organized seismic net of seven first class stations and of ten of the second class, among the latter that of Petropavlovsk in Kamchatka. According to seismograms of the Central Seismographical Station at Pulkovo, the geographical coordinates of the epicentre of the earthquake on January 30, 1917, proved to be as follows

$$\varphi = 54{,}^{\circ}5\,\mathrm{N}$$
$$\lambda = 159{,}^{\circ}7\,\mathrm{E\ (Gr.)}.$$

This point is situated 180 km NNE of Petropavlovsk in Kamchatka on the eastern coast. The initial moment of the earthquake at Pulkovo $iP = 2^h55^m35^s$, maximum amplitude of soil displacement at Pulkovo proved to be exceedingly great, $x_m = 2{,}3^m/_m$.

By means of the value of x_m and taking into consideration the dispersion of seismic energy with its propagation from the epicentre,

[1] They may be found in the „Catalogue of Earthquakes in the Russian Empire" by J. Mushketov and A. Orlov. Bull. Geogr. Society, vol. XXVI. St. Petersburg. 1893.

as well as the absorption of the energy by the earth layers, the value of the soil displacement in the areas proximate to the epicentre may be approximately calculated. Taking the coefficient of absorption $k = 0{,}00025$ and $x_m = 2{,}3^m/_m$ for Pulkovo, it appears that at a distance of 100 km from the epicentre x_m must be equal to 9 cm for the period $T_p = 45^s$. According to a telegraphic communication from the observer Purin of the seismic station at Petropavlovsk, during the earthquake magnets in seismographs were displaced and soil displacement reached 8 cm, i. e., it closely corresponded with the calculated value. Further, the observer reports, that at Petropavlovsk the shocks were smooth in character and although in some houses suspension lamps oscillated, many people were not aware of anything having happened. But the earthquake was much more acutely felt at the village of Kluchevskoye, where from 2^h47^m (Gr.) „during five minutes the earth was moving like a sea; many became sea-sick; furniture and beds were moved from their places, people awoke from their sleep; clocks stopped; chimneys fell down; trees rustled; people ran out frightened; mothers seized their children; some people fell on their knees and prayed; animals got agitated; flocks of birds left the trees and soared in the air; the same was observed at other points over an area of up to 430 km. No such seismic activity was remembered to have occurred by the oldest inhabitants; yet no people were injured; no data on the earth's surface disturbances are forthcoming. The Kluchevskaya volcano is in feeble activity. According to Kamchadales, an unknown volcano is smoking in the depth of the peninsula".

With equal intensity the earthquake was perceived in the Bering Island, while fissures in various directions appeared on the earth's surface.

It may seem strange why, in spite of the exceptional intensity of the earthquake registered by seismographs, no disturbances of the relief had been observed, and the earthquake was generally felt much less acutely, than might have been expected. At Petropavlovsk, for instance, a soil displacement of 7—8 cm caused no damages whatever. The explanation evidently lies in the incidence of a large period of oscillation of 40—60 sec., wherefore the acceleration had not reached the value sufficient to cause cohesion disturbances in rocks.

In this respect Kamchatka presents an interesting peculiarity.

While other seismic stations for proximate earthquakes produce

seismograms consisting of movements of very short period, at Petropavlovsk, in *intense* proximate earthquakes waves of comparatively large period are being observed (e. g., on July 31, 1916). This circumstance appears to be connected with the fact that the stratum of vulcanic magma underlies a thin superficial layer of the earth's crust. Geotectonic processes causing earthquakes are developed in rocks deposited at a certain depth, the movement being transmitted to the day surface through a layer of magma and, the comparatively thin superficial crust reposing on a plastic layer, performs smooth wave-like movements of large period.

But as has been mentioned, movements of such a kind are being observed only in catastrophic earthquakes that are registered by distant stations of the world. In cases of purely local earthquakes, which may be perceived by the inhabitants of Kamchatka but not registered by distant stations, the soil movements are of the usual type common to proximate earthquakes.

The seismological service on the Pacific coast according to the programme of the Academy of Sciences was to rely upon three seismic stations: one first class station at Vladivostok and two second class stations at Petropavlovsk in Kamchatka and Alexandrovsk in Sakhalin respectively.

The station at Petropavlovsk operating since July 1915 is provided with heavy horizontal Golicyn's seismographs for mechanical registering, installed in a semi-underground cement pavilion built for that purpose.

The equipment of the station in Sakhalin was completed in the summer of 1917, though observations could not yet be proceeded with on account of certain defects in the building. Subsequent events in our country, the scope and effects of which do not yield in magnitude to seismic cataclysms, prevented the Academy of Sciences from completing in due time the organization of the seismic service on the Pacific coasts. However, we hope that by the end of the current or, in any case, at the beginning of the ensuing year the first class station at Vladivostok will be opened. It will be followed by those in Kamchatka and Sakhalin, for which the requisite installation is being prepared.

In spite of the fact, that the organization of a regular seismological service in the Pacific Ocean is not yet completed, our country

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(born in 1797, died in 1879)

possesses an extensive seismological net provided with first class appliances of the Academician Golicyn, which have enabled us to register, at a distance of many thousands of km the most important manifestations of seismic activity on the Pacific. Since 1909 the Russian seismological stations annually register 86 earthquakes on an average, which, thanks to our instrumental evidence, we are enabled to relegate with perfect confidence to the Pacific Ocean, of which 10 proceed from Kamchatka and the Aleutian Islands; 35 from the Kuril Islands and Japan; 32 from the Philippine Islands and the Malay Archipelago, 7 from Australia and the neighbouring archipelagoes; 1 from North America, and one each from Central and South America.

Data on the above earthquakes are published in the Bulletins of our seismological stations, and we hope that their study as well as that of the evidence furnished by other countries will lead to results useful to science and humanity.

It remains but to say a few words on the determination of the force of gravity by Russian scientists in the Pacific Ocean.

The first determinations of g were made by commander Lütke during his voyage round the world by means of a second pendulum of Kater, and they refer to the following points: 1) Chili — Valparaiso (+0,018); 2) the Carolines — Ualan (+0,311); 3) the Mariana Islands — Guam (+0,195); 4) Bonin Island — Port Lloyd (+0,341); 5) Kamchatka — Petropavlovsk (+0,078) and 6) Alaska — Novoarkhangelsk (+0,001). Lütke's observations belong to the earliest in the Pacific, only four gravimetric points having been previously determined in 1818—24 by the French investigators Freycinet and Duperrey and two by the Englishman Hall in 1822. Furthermore, Lütke's observations confirmed by others led to the establishment of the remarkable fact, which furnished grounds for the theory of isostasy, of the huge positive anomalies of gravity in the Pacific islands; thus in Bonin Island $\Delta g_0'' = +0{,}341$; in the Carolines $\Delta g_0'' = +0{,}311$; in the Mariana Islands $\Delta g_0'' = +0{,}195$; these anomalies belong to the largest ever observed.

In 1896 Witram determined g for Vladivostok (+0,048), for Khabarovsk (+0,031) and for Hong-Kong (+0,002); M. Zhdanko determined in 1900 — 11 for Wafanden (+0,112), Port Arthur (+0,067), Tornton Bay (+0,160), for the Soviet (form. Imperial)

Harbour (— 0,091) and for De Castries Bay (+ 0,003). This evidence is too scarce to enable one to draw any positive conclusions as to conditions of equilibrium or to the structure of the earth's crust on the Pacific coasts of Asia, though they reveal some most interesting correlations. These observations were but reconnaissance work, but we hope that Russian science will be able to lay before the next Pan-Pacific Congress a more detailed account of the distribution of gravity within the limits of the Pacific possessions of the USSR.

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Terrestrial magnetism

by An. Belobrov

Hydrographical researches that were undertaken on the coasts of the northern part of the Pacific prior to the last quarter of the XVIIIth century are now regarded as bearing but the character of reconnoitering work. Expeditions of that time could not therefore give any material of much value on terrestrial magnetism.

The first records relating to the elements of terrestrial magnetism of this part of the Pacific coast were supplied in 1789 by the English expedition of Cook (Clerk and Gora) from four points.

Subsequent materials, concerning the Russian coast and islands, as well as other islands of the Pacific Archipelago and those of Japan, were collected by Russian expeditions.

Among the earliest observations we possess on magnetic inclination and magnetic intensity, may be mentioned those taken by the expedition of the famous physicist Lenz on board the „*Seniavin*" that sailed round the world in 1826—29 under the command of commander Th. Lütke.

The scientific study of terrestrial magnetic elements, coupled with hydrographical researches and observations (which thanks to their accuracy have not yet lost their value), dates since the year 1865, when the Russian Academy of Sciences had put at the disposal of the expedition all the instruments required. From that date and until 1893 Staritski, Elagin, Onatsevich, Klykov, Stenin and Maydel had determined the magnetic elements of above 80 points in the Japan, Okhotsk and Bering Seas and the Bering and Tartary Straits (including those, where observations were repeatedly taken during several years).

At the same time the magnetic declination at various points has

been determined with the help of bearing compasses by naval officers of the Pacific squadron.

Since the organization of the Hydrographical Pacific Expedition in 1898 magnetic observations were being conducted in a more systematical manner.

From this date till the year 1920 various observations at more than 330 points had been carried out by the hydrographic geodesists Zhdanko and Davydov and the hydrographers Neelov, Ivanovski and Mashkovtsev in the Yellow, Japan, Okhotsk and Bering Seas, as well as in the Tartary Strait.

In the predominating majority of cases magnetic, in addition to astronomical, observations, were being conducted at astronomical points: whence an idea may be formed of the total number of magnetic points. In the more important harbours such observations were repeatedly made during a period of several years.

Observations of the Hydrographical Pacific Expedition were carried out according to the instructions accepted in Russia and drawn by the Academician Wield by means of Girgenson's theodolite N° 2 (Lamon's system) with the inclinator of Krause.

Attention at that time was also drawn to the necessity of having the instruments used by the expedition compared with the standards of the Magnetic Observatory at Pavlovsk (near Leningrad), for which purpose they were twice brought from Vladivostok to Pavlovsk.

Materials gathered have been published from time to time in the sailing directions and the charts of the above-mentioned seas.

In 1926 magnetic observations were made by the Hydrographical Expedition of the Pacific Ocean at 13 different points of the sea of Japan.

Studying all the materials gathered, we come to the conclusion that the only two places of magnetic anomalies found on the Pacific coast belonging to the USSR fall within the area of the eastern coast of Kamchatka.

This material enables us further to draw certain conclusions as regards the secular variations of each element. According to the present point of view, however, magnetic surveying must have for its foundation a most reliable base, which can only be supplied by a magnetic observatory. It is therefore proposed at the first favourable

opportunity to establish magnetic observatories at Vladivostok and, subsequently, at Petropavlovsk in Kamchatka. At present, as a temporary measure, observations will be annually made at Vladivostok, by the Hydrographical Department, as is already done at all the points included in the magnetic system of the USSR.

From this cursory review it may bet seen that the Hydrographical Department of the USSR is of the opinion that magnetic observations should be carried out in addition to hydrographical works and should pursue not only practical aims in connection with navigation, but have purely scientific objects as well. Therefore, the methods of work, as well as the instruments, by means of which magnetic observations are carried out by hydrographical expeditions are in full agreement with the demands of scientific inquiry.

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Oceanography

by V. Akhmatov

Scientific researches, which form part of the science of oceanography, were carried out in many of its sections dealing with the Pacific Ocean by Russian scientists, who may be considered pioneers in this matter.

Russian navigators at the beginning of last century, who sailed to Russian North America, also pursued scientific researches, making a special study of the oceanographical conditions along their route.

To enable their surveys to be carried out in a thorough manner, the staff of the expeditions was composed not only of capable commanders and experienced officers, but also of scientific specialists.

Krusenstern, for example, in 1804, together with Horner were the first to investigate in seven different places the vertical distribution of temperature at different depths of the Ocean with the aid of a Six thermometer.

The expedition of Kotzebue, ten years later, took soundings and for the first time made observations on the transparency of the water.

In 1824 during the second expedition of Kotzebue, one of its staff was the famous physicist E. H. Lenz who was the first to apply the water bottle for obtaining samples of water at various depths in order to measure its specific gravity. He was the inventor of the method of using a protector for the thermometer guard against water pressure and taking thermometer readings up to a depth of almost 2.000 m. Thanks to these improvements and account being taken of the corrections due to the effects of the pressure of water and to the change of temperature during the raising of the apparatus from the depth,

the observations of Lenz gave the first correct idea of the temperatures in the depths of the Ocean, and his figures have not yet lost their value.

Relying on these observations, which unmistakably prove the gradual fall in temperature as the depth of water increases, the fall being at first rapid and then continuously growing slower, E. Lenz could establish in his works published in 1831 and 1847 the theory according to which the warm equatorial waters tend to spread on the surface towards the polar regions, the cold waters from thence travelling along the ocean bed towards the equator, where they rise to the surface.

The observations on specific gravity made over large areas of the Pacific Ocean enabled him to establish the existence on each side of the equator of zones of water of greater density and, consequently, of greater salinity confining a region of water of less density and salinity near the equator, whereas in the polar regions the salinity decreases.

Both these theories have since proved, in the course of further investigation, to be quite correct.

Of other, less important facts observed during the voyages at the beginning of last century may be noted the discovery of the equatorial counter-current in the western part of the Pacific Ocean, made by Th. Lütke in 1826—29, which was also recorded from its eastern part by J. Krusenstern in 1803—06. The latter also in his work „The Atlas of the South Sea 1823—26 with Explanatory Notes" indicated for the first time the existence of the East Australian Current.

In the thirties of last century interest in the circumnavigation of the world had apparently ceased, and voyages were no longer arranged on a scientific basis, although ships navigating the Pacific Ocean continued to record their observations relating both to meteorology and to the study of the surface water.

In the sixties, after the Brussels Conference, Russian ships commenced to keep their log books on the international model.

Taking into account the above-mentioned researches, the Academician Schrenck in 1869 was able to write „An Essay on the Physical Geography of the North Japan Sea" and in 1874 to issue a book on „The Currents of the Okhotsk, Japan and adjacent Seas".

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(born August 6, 1815, died January 16, 1894)

In the above he collected all the records he could find concerning the oceanography of these seas, pointing out their peculiarities and showing the relationship between the temperatures of water and air, etc., and in so doing laid a foundation for the proper study of the subject. So, for example, he discovered the so-called Tsushima Current, which flows accross the Korea Strait to the Japan Sea, traced out a stream of cold current flowing from Gizhiga Bay to the Sea of Okhotsk, etc.

New facts rapidly accumulated and were at that time increased by analysis and observations relating to the density of deep waters. In the sixties and seventies several men worked very hard in collecting this information, among whom K. Staritski, Onatsevitch, Maydel, Zuev and several navigating officers may be mentioned.

Onatsevitch published in 1876 a „Collection of Researches recorded during hydrographical voyages in the Pacific Ocean (1874—77)", in which he gives very important notes and hydrological tables. Maydel also wrote several articles, published in the „Morskoi Sbornik", on the temperature and density of the water, this subject having been studied by him for many years. Dr Zuev's work concerning the surface temperatures of the Japan Sea was published in the „Notes on Hydrography" in 1887.

All this work, however, represented a series of unconnected essays, due to private enterprise, which was not put together in serviceable form until the end of the eighties, when the corvette „*Vitiaz*" appears cruising in Pacific waters under the command of S. Makarov: sailing round the world from 1886 to 1889, he made systematical researches in hydrology. His work consisted in recording the temperature and relative density of the sea, both at the surface and at different depths, ascertaining the velocity of the currents on the surface and at different depths, taking soundings and collecting samples of the ocean bed and of water.

The temperature of the surface water was logged every four hours whilst under way. The density was taken once a day at noon and later was logged every four hours. Whenever the outer boundaries of the currents were traced, records were logged more frequently, and the temperature and density of the surface water were measured every five or ten minutes during several hours' cruising.

At the deep water sea stations, of which there were 261 on the whole, samples of water were taken by a water bottle of particular

construction at depths of 25, 50, 100, 200, 400 and in some places even down to 800 m. In places where it was necessary to determine the existence of layers of varying density, the measurements were taken also at intermediate depths.

These observations were carried out with great care and attention and were afterwards collected in a thorough and scientific manner. The author Makarov considered it necessary to incorporate the records collected during his voyages in the Pacific Ocean with those of other explorers. He was obliged to do this because the work done on board the corvette „*Vitiaz*" alone was insufficient to give a correct and exact idea of the physical conditions of this ocean. It was also impossible for one man to make a proper survey of all the other oceans, and that is the reason why Makarov preferred to confine himself to giving us records of the log books and tables for one ocean only, namely, the Pacific, in his work entitled „The „*Vitiaz*" and the Pacific Ocean".

In this book he has collected records of observations on the temperature of the surface water taken from 78 vessels, of the temperature below the surface taken from 30 vessels and of the density of the surface water taken from 5 different vessels. Besides records of foreign scientific expeditions derived from printed articles (the number of which corresponding to the above given of vessels being 15, 14 and 3 respectively), numerous log books from Russian ships were utilized. The data used by him, covering the period from 1804 to 1890, were thoroughly revised and minutely examined, and his work always closely follows the original records. The vastness of the number of figures collected may be judged by the fact that in arranging the data referring to the temperature of the surface water the Pacific Ocean was divided into 8.000 one degree squares, some of which had been traversed by as many as 20 ships per month, although of course many of the squares remained completely unfrequented.

The result of this work enabled Makarov to prepare five different charts with isolines to show the density of the surface water of the whole North Pacific Ocean, Japan and Okhotsk Seas, China Sea, La Perouse Strait and Formosa Strait along the track of the NE monsoon; eight charts showing the temperature of the surface water of that Ocean, and of the Japan and Okhotsk Seas, and the La Perouse, Korea, Formosa, Bering and the Fourth of the Kuril Straits

and Gizhiga Bay; two charts of isotherms of the surface water for August the 16th; one for the Japan, Okhotsk and Bering Seas and the other for Formosa Strait, and last, a very important chart of the isolines of the temperature of water 400 m deep and a number of diagrammatic curves.

All the observations which had been carried out on board the „*Vitiaz*" led to conclusions of which it may be interesting to note the following: the depth of the equatorial current slightly exceeds 200 m, that of the counter-current being less, as at a depth of 100 m the velocity of the water differs from that of the surface; to fully understand the peculiarities of these currents it would be necessary to take account of the anomaly recorded in the area defined by latitude 0° to 5° N and longitude 105° to 120° W, where the water is colder (by 3° to 4°). The tracing of the boundaries of Kuro-Shiwo showed that its eastern limit cannot be properly defined, whereas the northern limit distinctly leads across the projecting capes SE of the Japanese coast. The density of the Inland Japan Sea is much inferior to that of the adjacent waters of the Ocean and the Japan Sea. The researches made in La Perouse Strait have shown that the warm current of its southern side moving eastward and the cold current of the northern side of the strait going west have a distinctly inclined and not a vertical border line. The lighter in weight, but colder water of the Okhotsk Sea spreads like a wedge over the warmer but heavier waters of the Japan Sea, which in their turn extend far to the NE below the surface.

In the Formosa Strait observations have shown that under the influence of the tide the water becomes so mixed as to have the same salinity and temperature from top to bottom.

The tables and charts which he had prepared enabled him to establish certain theories and deductions, some of which we here reproduce.

With regard to navigating near the Kuril Chain, M a k a r o v points out the necessity of taking the temperature of the water as frequently as possible, as, owing to the prevailing fogs, this method may be a useful guide to navigation. It is only natural to assume that in all the straits adjoining this chain, commencing from the island of Uturup, the water is colder than in the adjacent seas and that the coldest region is more likely to project towards the Pacific Ocean than towards the Okhotsk Sea.

Studying the chart of the temperatures of the surface water of the Pacific Ocean and the isotherms for August, Makarov indicates that the SW quarter of the Ocean has a temperature from 26° to 29°, whilst the SE quarter has one from 20° to 25°. In the eastern part the isotherms curve towards the south, and this incurvation is reproduced by the lines of the densities chart, indicating the trend of the Californian Current. In comparing this chart with the chart of the densities, it becomes evident that the high temperature and salinity region is situated in the western part of the sea in the track of the NE trade wind. This region having a density of 1.0270 is surrounded by a wide circular belt of water with a density of 1.0269 to 1.0265. With regard to the specific gravity of the deep water it is practically the same throughout the Ocean, and the average can be taken as 1.0265.

Referring to the currents, Makarov lays stress on the influence exerted upon them by the rotation of the earth and to which he attributes the deviation of the current of the Sangar Strait on reaching the Pacific Ocean to meet the powerful Kuro-Shiwo.

The general circulation of the water in the Pacific Ocean presents itself to him as follows. The equatorial current going west forms in the western part of the Ocean, between the tropics, a certain swelling on the surface of the sea, in consequence of which its waters deviate along the Philippine Islands towards the north and join the Kuro-Shiwo stream. The latter travels NE washing the shores of Formosa and Japan. The equatorial current does not pass through the Philippine Islands, which circumstance may be demonstrated by the water in the Sulu and the Philippine archipelagoes being of far less density.

The Kuro-Shiwo Current, on reaching the Chinese shore, divides into three parts. The main stream travels NE and following both sides of Formosa bears the name of Kuro-Shiwo, the third branch turning west and encircling the China Sea in an anti-clockwise direction. This last branch, first pointed out by Makarov, is still nameless and is separated from the land by a belt of water of inferior salinity. Approaching the shores of Japan and the Korean Peninsula, the Kuro-Shiwo divides again into three parts. The main branch follows the eastern shores of Japan, the second crossing the Korea Strait falls into the Japan Sea and forms the Tsushima Current, discovered by Schrenck, and the third,

pointed out also by Schrenck, turns west and apparently makes a circular track similar to the one referred to in the South China Sea.

The Tsushima Current entering the Japan Sea turns to the right and follows the Japan shore towards the NE. Reaching the Sangar Strait it separates, leaving the greater part of its water in the strait. The remaining part goes north, at the same time bifurcating again at the La Perouse Strait, so that only a small portion of the original stream skirts Sakhalin.

The main branch of the Kuro-Shiwo swiftly flowing through the Van Diemen Strait and coming into contact only with the projecting capes of the eastern coast of Japan, does not enter the bays or the Inland Sea. Approaching Inaboysaki it turns towards the east; but apparently during the end of the summer it turns further to the north, not, however, much further north than 40° latitude. In this latitude the stream of Kuro-Shiwo with a density of 1.0260 moves eastwards. It is interesting to note that water of equal density can be found in the Bering Sea at depths below 200 m.

With regard to the Okhotsk and Bering Seas, particulars of which were too scarce to be marked on maps, Makarov indicates in the western part of the sea, between the upper and lower warm waters, the presence of a layer of cold water, more than 200 m deep at the coast and diminishing as it approaches the centre, where it completely disappears.

Referring, then, to the Amur, he declares that the greater portion of its water on entering the sea turns sharply to the right, skirting Sakhalin and proceeding south. Concerning the question of what water feeds the basin of the Okhotsk Sea, Makarov thinks, it may flow from the south and probably by way of La Perouse Strait.

With regard to the temperature of the water of the Bering Sea, he concludes that off the Asiatic coast the water is cold throughout its depth, whilst off that of America it is warm. The specific gravity records show that even in the latitudes of 60° to 62° the water is greatly influenced by the Arctic Ocean and is not fed, even indirectly, by the warm waters of the southern latitudes.

Concluding thus this short review of the abundant information contained in „The „*Vitiaz*“ and the Pacific Ocean“, which was, by the way, published in both French and Russian, let us consider further contributions to this subject. They chiefly consisted in

collecting of oceanographical notes obtained from two sources, one being the hydrographical coast stations which grew rapidly in number, and the other war and merchant vessels as also vessels of hydrographical expeditions. It is to be regretted that all this important information has hitherto been only partly dealt with in the sailing directions of these seas and in disconnected articles. Since Makarov, no attempt has been made to prepare a systematic treatise on the subject. By extracting all the information it was possible to collect, we are able to give the following sketch of the oceanographical study of the Pacific Ocean.

The currents of the Bering Sea have some connection with the direction of the winds which are dependent on the seasons. In winter, from the sea between Kamchatka and the far west of the Aleutian Islands a current flows to the Ocean, where it joins a current coming from the Okhotsk Sea across the Kuril Chain, thus forming the cold current Oia-Shiwo, that flows SW. At cape Kankvasan (38° N lat.) it meets the Kuro-Shiwo, which in winter reaches the 40° N lat. only, between 150° and 170° E long. Near the American coast the Kuro-Shiwo divides into the Californian Current and another flowing towards the Alaska Bay. The latter flows further towards the Bering Sea, where it becomes a compensating current for the Oia-Shiwo. During the spring season, in consequence of the reversal of the monsoons from NW to SE, as also of a strengthening of the south winds, the cold current moves northward. The west side of Bering Sea, beginning with the month of May, commences to become appreciably warmer and rids itself of ice. During summer, the Kuro-Shiwo enters the above-mentioned regions of the Ocean from a NE direction and then deviating to the E at about 160° E long., a branch detaches itself which flows to the Bering Sea and is known on the Kamchatka coast as the Kamchatka Current. In summer the eastern and northern sections of the Bering Sea are found to be the warmest, the American side in this part being warmer than the Asiatic. In the autumn the west winds becoming more frequent draw the Kuro-Shiwo southwards. The Alaskan Current branches off at about 43° N lat. slightly more to the south than in the summer. The water cools down rapidly, the Oia-Shiwo swiftly develops, being invigorated by the waters of the Okhotsk Sea, which in its turn, owing to the NW monsoon blowing from the

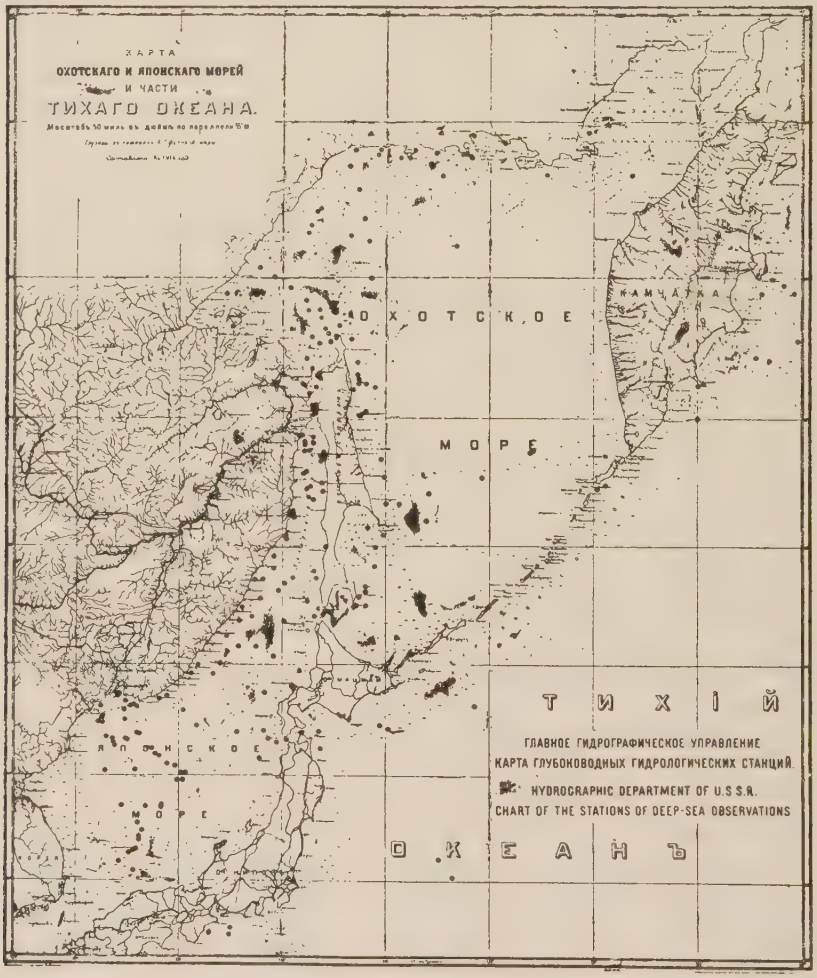
continent which has become colder, cools down faster than the Bering Sea.

A revision of the observations collected by the Hydrographical Expedition of the Pacific Ocean undertaken during the first quarter of this century originally under the leadership of M. Zhdanko and then of B. Davidov for the investigation of the Okhotsk Sea, shows that similarly to other enclosed basins of the northern hemisphere its waters flow in a circular direction, contrary to that of the sun. This movement, weak in comparison to periodical currents, occurs in the open sea, and not in bays or gulfs which in most cases have their own tidal currents. The greater part of the Amur waters leaving the estuary flow towards the Okhotsk Sea and in Sakhalin Bay skirt the shore; then, rounding capes Maria and Elizabeth, join the main current of the sea, which flows along the eastern shore of Sakhalin with a diurnal velocity of 10 to 15 miles. At the La Perouse Strait the Okhotsk Sea waters are joined by a branch of the current coming from the Japan Sea, by which their speed is increased. The stream later discharges itself partly into the Ocean across the southern Kuril Straits, and partly turns northward, forming a current in the eastern portion of this sea. At the entrance to the Penzhina Bay it divides, and the smaller branch flows round the bay in an anti-clockwise direction, expending itself north in the parallel of Cape Taigonos. The main stream with a diurnal velocity of 15 to 20 miles flows round the northern seashore. Following the contours of the coast up to the meridian of Taui Bay, the current begins to deviate towards the SW, passes St. Jonah's I. and Uda Bay and then turns eastward along the SW coast, passing the Cape of Mukhtel, to as far as Reinecke Island. Near the latter the stream again divides, one branch flowing east to Cape Maria, and the other turning SE, passes the coast of Sakhalin Bay and, mingling its waters with those of the Amur, proceeds also towards Cape Maria.

The above is a general outline of the currents, based on the hydrographical observations of temperature, densities of water at different depths, and also of the tracks of bottles, several thousands of which had been thrown into the sea and of which almost six hundred were afterwards found.

In the larger bays of the Okhotsk Sea were discovered tidal currents of considerable strength. The highest velocity of 6 to 7 knots was

discovered to occur near the Shantar Islands, in Penzhina Bay, in Uda, Gizhiga and Taui Bays. The high tidal currents along the eastern coasts of Sakhalin, and western Kamchatka and in Penzhina Bay all flow towards the north, along the northern coast westwards, and the northwestern southwards. The low tidal currents flow in the reverse directions.



The altitude of the tides differ: near the southern coast of the Okhotsk Sea the flood tide reaches $7\frac{1}{2}$ ft. (2.25 m), and the neap tides $5\frac{1}{2}$ ft. (1.7 m); along the western coast 9 ft. (2.7 m) and 5 ft. (1.5 m) respectively; on the northern coast $10\frac{1}{2}$ ft. (3.3 m) to $4\frac{1}{2}$ ft. (1.4 m) and along the eastern 10 ft. (3.1 m) to 3 ft. (0.9 m) respectively.

The tidal wave enters the Okhotsk Sea from the Ocean and spreads from there to the west and north over all its area. This has been proved by the tidal constants established for different places and also by the retardation of the tides with regard to the moon. The incidence of one high water in syzygy and two in quadrature is general in this region, so that from the flood to the neap occurs a gradual formation and increase of the second flow to the detriment of the main flow, which gradually decreasing in height becomes equal in height to the second. Such is the general character of the phenomenon, which changes only under local conditions. In spacious bays the amplitude of the high tides sharply rises from 20 ft. (6 m) to 30 ft. (9 m) and even to 37 ft. (11,5 m) at the extremity of Penzhina Bay. The increase of the amplitude immediately affects the velocity of the tides, which reaches 7 and even 8 knots in the narrows.

The temperature of the surface water of the Okhotsk Sea in July and August varies from + 10° to 12°, the density being about 1,0246 — 1,0247. Owing to the continual fogs, the water does not become warm during the summer period, therefore almost everywhere, after a rapid fall in temperature in the layers of water from 5 to 10 fathoms (9 to 18 m), at a depth of 10 fathoms the water has a temperature near zero. The fall of temperature continues with each increase in depth and reaches temperatures under the freezing point, although not so rapidly. The density also increases, but the amount of 1,0255 to 1,0257, reached at the depth of 30 to 40 fathoms (50 to 60 m), is the same right to the bottom.

As a peculiarity of the sea we must point out several patches of cold water: first, in the region of Yamski Islands and westward of them, then one, but much smaller, near St. Jonah's Island and some long patches of cooler water on the line of Cape Elizabeth, St. Jonah's Island, Cape Alevin, as also throughout the whole breadth of the entrance to Penzhina Bay, the temperature of water being 3° to 5° lower than the normal. The density of the water in these patches is above the normal and goes on increasing with the decrease in the temperature. Taking this into account and the general direction of the currents, we must admit that these patches are caused by the bulging out of the deeper layers towards the surface. So, for example, in the eastern part of the sea the whole mass of water moving northward on its way meets a shallow bank,

between Capes Tolstoi and Alevin, and ascends it as if it were a battering ram. The deeper layers rise to the surface, the result being that this area is filled with exceedingly cold water of about + 3° to + 4°. In the region of these cold patches the above-mentioned character of the fall in temperature abruptly changes. From a temperature of + 3° the decrease is gradual without abrupt leaps and in greater depths of 60 to 70 fathoms (110 to 120 m) it approaches zero. The density of water from 1,0253 on the surface very slowly reaches 1,0256. It is quite evident that the water is here well mixed up. These cool patches account for the formation of fogs. In summer the hot and damp air sweeping over the cold patches yields part of its moisture which forms the fog. From these cold tracts the fogs gradually spread with the aid of a light breeze all over the sea, disappearing entirely only in places that are sufficiently heated.

Notwithstanding the severe frosts, the Okhotsk Sea freezes only round the coast in a belt of 40 to 50 miles (75 to 90 km) wide, its gulfs and bays being completely covered with ice. The period of frost commences during the first half of November, and the accumulation of ice continues up to February, and in the northern parts till March, when the temperature rises to zero, the accumulation of ice ceases, and in May the ice begins to thaw simultaneously with that of all the coastal rivers. The combined efforts of the wind and tide break the ice, and it commences to move with the current. At the end of May and the first half of June it begins to drift through the Kuril Range towards the Ocean. Generally, during the second half of June the Okhotsk Sea is almost free from ice. At this time of the year ice can be found only in the western part of Sakhalin Bay in the SW corner of the sea. There the ice keeps firm until the second half of July and sometimes even until August, as was the case in 1915.

Coming to the end of this account of the Okhotsk Sea it is only necessary to mention that its salinity on the surface can be expressed in figures from 31‰ to 32,5‰, reaching at the bottom 33,4‰ to 34,3‰. Near the coast the water is fresher, being 27,5‰. The transparency of the water is considerable, yet less than that of the Japan Sea. A white disc disappears at a depth of 29 to 37 feet (9 to 11 m), whereas in the Japan Sea it is visible in some places at a depth of 65 feet (20 m). Naturally, near rivers the transparency becomes

less, as, for example, at the mouth of the Yana the figures were only $2^1/_2$ feet (0,75 m). It may be finally added that the relief of the bottom based on later experience is apparently as follows: throughout a line drawn from Cape Elizabeth to Sakhalin and Yamski Islands almost everywhere to the northwest the depth was found to be not less than 100 fathoms (185 m). Such shallow water occurs also in the Penzhina Bay. Southward and SE of this line the depth gradually increases, and on a line from Cape Patience to Lopatka the depth of the middle basin would be 1,000 fathoms (2,000 m). The depth further increases and at the deepest place sounded was over 1,800 fathoms (3 km), which is situated near the southern half of the Kuril bed. In this manner the bottom rises suddenly from the deep basin of 1,500 to 1,800 fathoms (2,500 — 3,300 m) to the coast of Matsmai, Sakhalin and Kamchatka, becoming more sloping northwards along the middle of the sea, where, rising at the latitude of 50° to 200 fathoms (370 m), it has a still more gentle slope, especially in the extreme NW and SW parts of the sea.

With regard to the Japan Sea the researches of later years give quite a distinct confirmation of the existence of a cold current flowing along the west coast from the north with a diurnal velocity of 30 miles. Its greatest velocity was found to be between Cape Belkin and Cape Boltin, growing less further from the shore. Under the influence of this cold current the greater part of the waters of Kuro-Shiwo turn towards Sangar Strait, where in consequence of the narrow passage, the speed of the current rapidly grows to 40 miles. At the same time the study of the tracks of bottles proves the presence of Kuro-Shiwo waters off the western coast of Sakhalin, but far from the continent and therefore having no influence on its climate. However, the winds exert an influence upon its speed and direction, the SW monsoon of the China Sea increases it and with the reversal of the direction of the monsoon it grows less strong and changes its course.

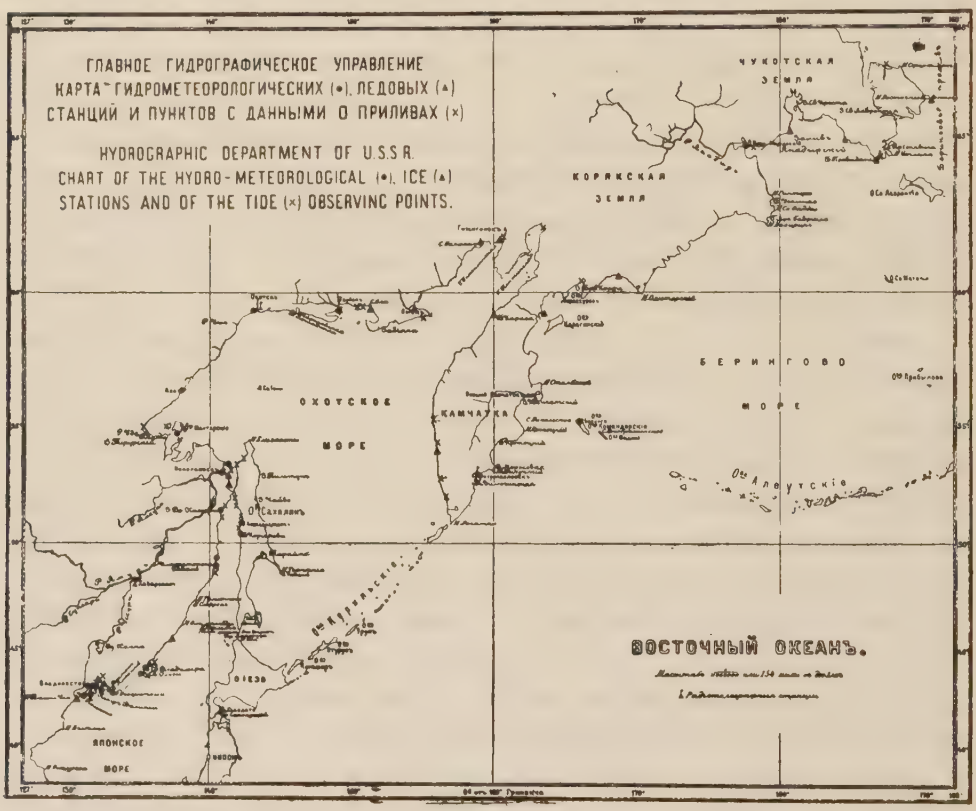
The tides of the Japan Sea, depending upon the waves coming from the Ocean through the Korea Strait are quite regular and exhibit but a slight variation in the height of the tide.

On the whole, the investigation of the tides of the Russian coast of the Pacific Ocean may be summarised as follows:

The harmonic constants of the tides are being calculated at

16 stations. Seven of these stations are situated in the Tartary Strait, seven in the Okhotsk Sea and two in the Bering Sea.

The tides are divided into groups according to their character: the group of the Tartary Strait is one of a regular semidiurnal type; they can all be compared with the standard point in De Castries Bay. The group of the narrow part of the Tartary Strait, and the entrance to the Okhotsk Sea have a semidiurnal tide with a large diurnal constituent; one part of the month, during the small declination of



the moon, occur two high and two low waters, the other part of the month during the great declination of the moon, the second high and low tides disappear and then the days have one high and one low water, when they can be compared with the tides of Langres Island. The third group of the SW region of the Okhotsk Sea has again a regular semidiurnal tide, but with amplitudes greater than the first. In the fourth and NE part of the sea the tides are very complicated: in Nagaev Bay two high and two low waters occur, but the levels of the adjoin-

ing low waters greatly differ from one another; in the close proximity of Udacha Bay the tide is almost exclusively diurnal, with almost imperceptible second high and low waters; in Penzhina Strait the tide is similar to that of Langres Island. Bering Sea has a semidiurnal tide, with the exception of Petropavlovsk, where it has a large diurnal constituent and amplitudes of 4 feet.

Utilizing all the information collected, the Hydrographical Department in 1915 commenced the publication of annual tide tables for the Pacific Ocean; hourly tables on the variation of the tide at the three principal stations: De Castries Bay, Langres Island and Nagaev's Bay are there given, as also the corrections for obtaining the time and level of the tides for the other twenty-seven coast stations.

The following is an outline of the manner in which oceanographical observations are being carried out in the Pacific Ocean at the present time. During all the hydrographical surveys the temperature and salinity of the deep waters are being recorded. Besides, since last year ships have been sent on specially appointed routes to investigate hydrological sections, as, for instance, in November 1925 along the meridians of 131° and 132°, when several biological researches have also been made. At every opportunity bottles were thrown to follow the course of the currents. To study the movement of the ice, since 1914 all ships have been supplied with special blank charts on which to mark the position and character of the ice with which they come in contact. These charts are subsequently sent to the Hydrographical Department for further study. Besides this, at twenty-two coast stations (eight in the Japan Sea, eight in the Okhotsk Sea and six in the Bering Sea) the observations of the ice are being carried out according to a special programme. Other twenty-five hydrometeorological stations (fourteen in the Japan Sea, five in the Okhotsk Sea, four in the Bering and two in the Siberian) make out records of the hydrological and meteorological elements. The records of these stations permit synoptical charts of the conditions of the ice in the Peter the Great Bay to be prepared.

Finally, for a continuous record of the tides mareographs have been installed at Vladivostok, Nikolaievsk on the Amur and in the Langres Island.

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Meteorology

by W. Wiese

The first meteorological observations on the Russian coast of the Pacific were made late in the XVIIIth century; they were begun in 1789 at Okhotsk. Since 1828 meteorological observations have been conducted at Petropavlovsk in Kamchatka and at Ayan (1847). In 1853 meteorological observations in Petropavlovsk were temporarily suspended and were renewed only in the eighties of last century. The most continuous series of meteorological observations were taken at Nikolaevsk on the Amur (during 68 years), Vladivostok (48 years), and Okhotsk (47 years). At Vladivostok they have been carried out since 1873 without interruption.

Up to 1913 the meteorological stations situated on the Russian coast of the Pacific worked under the general direction of the Central Physical Observatory,[1] the greater part of these stations being attached to the Chief Hydrographical Department of the Ministry of the Navy. In 1913 a branch observatory has been founded at Vladivostok, which has henceforth controlled the work of the meteorological stations. Besides this observatory, a Marine Observatory was established in 1904, which at present conducts the special weather service. The diurnal synoptical charts of this observatory were first published late in 1914; these charts are based on data obtained from Russian, Japanese and Chinese stations, as well as from the stations situated on the Philippines.

[1] Now the Central Geophysical Observatory.

LIST OF SECOND CLASS METEORELOGICAL STATIONS ON THE RUSSIAN COAST OF THE PACIFIC, BEING IN OPERATION DURING NOT LESS THAN 10 YEARS

MARITIME (PRIMORSKI) PROVINCE

Gamov, ph.	42°33′ N	131°13′ E	1908—26
Povorotnyi, ph.	42 11	133 03	1896—98; 1910—26
Novokievsk	42 43	130 47	1887—88; 90—91; 1911—13, 15—26
Askold, ph.	42 44	132 21	1876—78; 1911—26
Tizinkhe	42 45	130 58	1911—26
Skryplev, ph.	43 02	131 57	1897—98; 1911—26
Vladivostok, port	43 07	131 55	1873—1926
Nizmennyi, ph.	43 31	135 09	1906—07; 1909—26
Olga, post	43 44	135 16	1876—82; 1908—26
Vetka	43 46	135 07	1912—26
Nikolaevski, ph.	48 59	140 25	1901—02; 1904; 1908—09; 1914—16; 1918; 1923—26
Kloster Camp, ph.	51 26	140 53	1902—04; 1908—19; 1924—26
Nikolaevsk on Amur	53 08	140 45	1854—99; 1901—20; 1924—26
Ayan	56 28	138 17	1847—58; 1891—97; 1912

SAKHALIN

Crillon, ph.	45°54′ N	142°05′ E	1893—1903
Korsakovski, post	46 39	142 48	1877—83; 1885—1905
Rykovskoe	50 44	142 42	1887—1907; 1909—14
Duiski, ph.	50 50	142 06	1866—75
Jenkierski, ph.	50 53	142 07	1910—20
Alexandrovsk	50 54	142 10	1881—91; 1893—1905; 1909—20; 1926

PROVINCE OF KAMCHATKA

Petropavlovsk, ph.	52°53′ N	158°93′ E	1900—26
Petropavlovsk	53 00	158 49	1828—30; 1843—53; 1871—72; 1890—99; 1914—26
Medny (Copper) Island	54 50	167 28	1882—83; 1902—06; 1912—13; 1916—18; 1922—23
Bering Island	55 12	165 59	1899—1906; 1911—19; 1921—26
Okhotsk	59 21	143 17	1789—95; 1843—52; 1890—99; 1907; 1911—19; 1926
Gizhiga (Kushka)	62 02	160 40	1890—94; 1898—1908; 1914—20
Novo-Mariinski post	62 45	177 32	1889—92; 1898—1919; 1926

Besides the above mentioned the Russian coast of the Pacific possessed 45 second class stations, whose activity lasted less than

10 years, — of which we give below a list of those only that have been operating early in 1926:

Russki Ostrov (Russian Island) . . .	43°01′ N	131°53′ E
Turney	45 16	136 40
Kkhutsyn	46 06	137 56
Sovetskaia Gavan (Soviet Harbour) .	48 58	140 17
Ust Kamchatsk	56 12	162 26
Tigil	57 46	158 36
Langres Island	53 18	141 28
Shantarski Island	54 52	137 28
Nayakhan	61 55	158 59

Thus, early in 1926, 28 second class stations were working on the coast of the Pacific, being supported by 16 third class stations. The stations Gamov, ph., Askold, ph., Vladivostok, Nayakhan, Bering Island and Novo-Mariinski post are provided with radio installation.

The observations of the stations situated on the Russian coast of the Pacific were first published in 1835 in the „Review of magnetic and meteorological observations" issued by A. Kupffer, and later on (1865) in the „Annals of the Central Physical Observatory"; in the meantime some of these observations were published in the „Bulletin" and „Mémoires" of the Academy of Sciences, in the Reports of the Hydrographic Department and other publications. In 1912 the investigations of the meteorological stations began to appear in the publications of the Meteorological Observatory at Vladivostok; they have been brought up to 1915.

The first attempts to give a scientific account of the peculiarities characterising the climate of the Russian coast of the Pacific, based on the observations of Russian stations, were made by the Academician L. Schrenck in 1869 and 1876 and by the late Director of the Russian Magnetic and Meteorological Observatory in Peking H. Fritsche (1877). Data of much greater importance relating to the climate of the Russian coast of the Pacific were in the possession of the Central Physical Observatory when it published in 1900 its „Climatological Atlas of the Russian Empire". Most important material on different meteorological phenomena relating to the NW coast of the Pacific may be found in the works of H. Wild, A. Kaminski, A. Schoenrock and J. Kersnovski. A series of climatological papers dealing with more limited areas, for instance, the Okhotsk Sea, Sakhalin, Primorski Province, De Castries Bay and Vla-

divostok, etc., may also be mentioned. The sailing directions of the NW part of the Pacific and the Okhotsk Sea published by the Admiralty contain a wide range of meteorological researches and much important information.

Meteorological stations were likewise instituted in the former Russian dominions in the NW part of America, where continuous observations and of the longest duration were recorded at Novoarkhangelsk on the island of Sitka (1821—25; 1828—29; 1831—45; 1847—63), where in 1842 the Russian-American Company established a Magnetic Meteorological Observatory attached to the Academy of Sciences. During several years meteorological observations have been besides conducted by Russians in the Redoubt St. Michael (63°29′N, 198°16′E), Ikogmyut (61°47′N, 198°46′E), English Bay (60°N, 209°E) and St. Paul's Bay (67°47′N, 207°47′E).

Atmospheric conditions of the Bering Sea were first brought to light by the observations of Shayashnikov at St. Paul's Island in 1839—44 and of the missionary Veniaminov on the island of Unalashka in 1825—34.

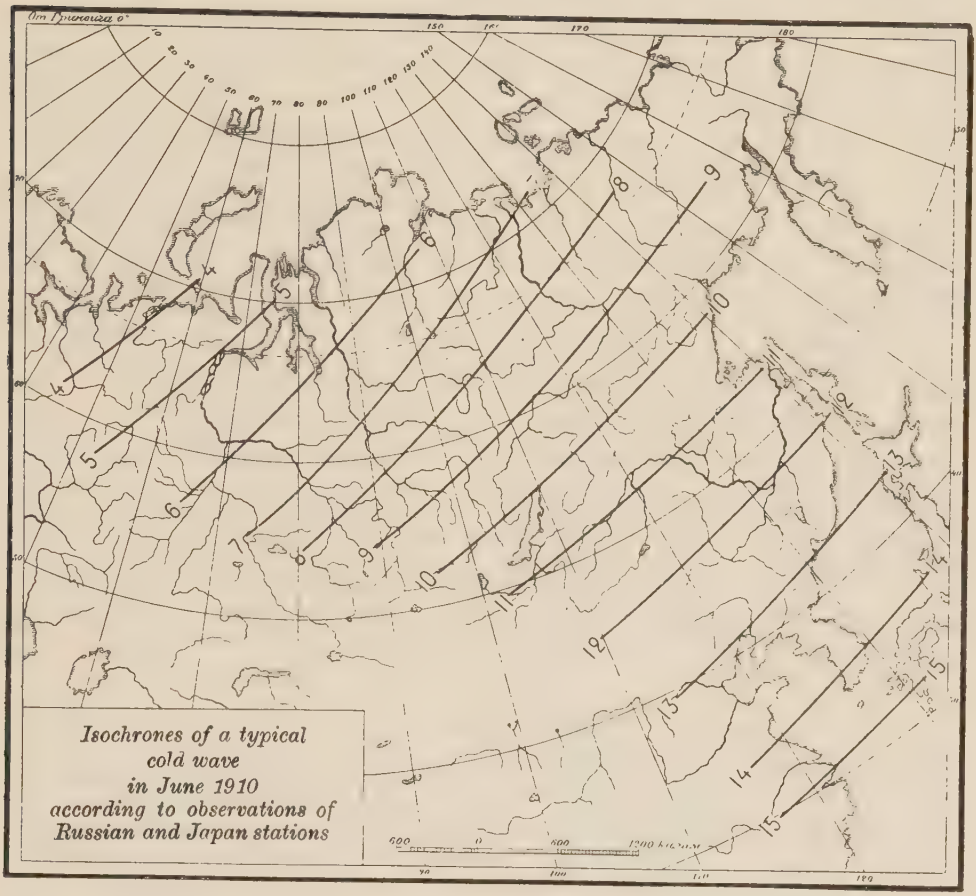
On the basis of these researches the members of the Russian Academy of Sciences C. Baer and C. Veselovski have given us the first description of the climate of NW America.

We must further mention the meteorological observations made by Russians in the seventies of last century at Hakkodate in Japan, at Tien-tsin and Taku in China, at Kelung on the island of Formosa as well as the observations of long duration conducted since 1841 at Peking, where in 1849 the Academy of Sciences had established a Magnetic Meteorological Observatory.

In 1803 was begun the most remarkable series of voyages of Russian sailors for the circumnavigation of the world, during which special attention had been paid to the study of the meteorological conditions in the oceans,—and, in particular, to the meteorology of the Pacific, which supplied abundant data. In the second half of last century meteorological observations were made on board the men-of-war that cruised in the Pacific, and since 1915 on board the vessels of the „Dobrovolny Flot" (for the weather service).

Finally, investigations of great value on the meteorology of the Bering, Okhotsk and Japan Seas were made by the Hydrographic Expedition to the Pacific Ocean. The observations carried out on

board the Russian vessels have mostly not been yet published and are at present in the possession of the Archives of the Chief Hydrographical Department. Among the observations published *in extenso* the following may be mentioned, as having been taken on board the „*Nadezhda*" and „*Neva*" in 1803—06, the sloops „*Kamchatka*" in 1817—19 and „*Otkrytie*" in 1819—22, the transport ship „*Krotki*"



in 1825—27, the sloop „*Seniavin*" in 1826—29, the „*Akhta*" in 1847—49 and „*Avrora*" in 1853—54, the corvette „*Varyag*" in 1864—67, the schooner „*Vostok*" and the clipper „*Vsadnik*" in 1874—77, the frigate „*Kniaz Pozharski*" in 1878—82, the clipper „*Oprichnik*" in 1883—86, the corvette „*Vitiaz*" in 1886—89, the ships „*Shilka*", „*Kolyma*", „*Okhotsk*" and schooner „*Nadezhda*" and „*Neptun*" in 1907—08.

Observations taken on board the Russian vessels during their sailings in the Pacific which have been published, as well as those that have not yet appeared, have been very little studied. Although the observations made by Th. Lütke on board the „*Seniavin*" have been utilized by the professor of the University in Helsingfors G. Hällström in one of the first works on the diurnal variation of the pressure of the atmosphere of the Ocean in the tropical regions. E. Lenz was the first to deal with the question relating to the diurnal variation of temperature in the tropical areas of the Pacific; his investigations were based on the observations taken by Dr Lenz on board the „*Akhta*" (1847—49) and the Academician Schrenck on board the „*Avrora*" (1853—54). These observations, as well as the observations taken on the „*Vitiaz*" have subsequently served as material for the most important work devoted to this subject of the Academician M. Rykachev.

Finally, we must mention that the records of meteorological observations entered in the log books and now preserved in the archives, afforded J. Spindler the necessary data for his special investigations on the tracks of the typhoons; the same records, in addition to the observations taken at Russian and foreign coast stations, supplied the requisite subject matter for the preparation of the charts of the winds and fogs in the Sea of Japan that have been issued by the Chief Hydrographical Department.

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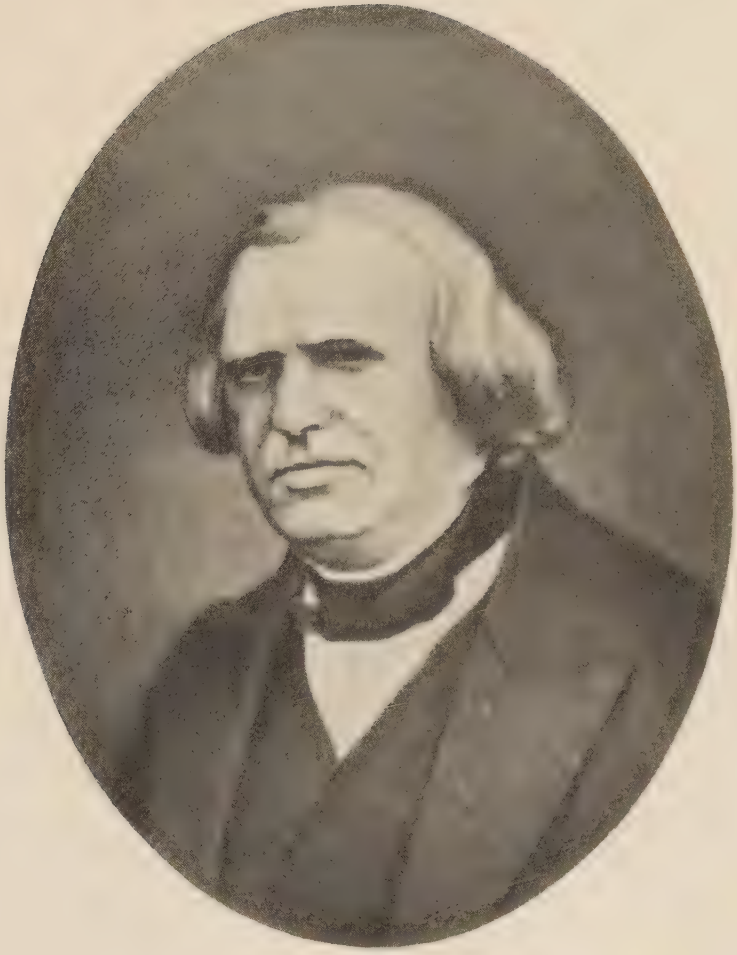


E. VOZNESENSKI
(born July 19, 1816, died May 17, 1871).

Botany

by V. Komarov

At the time when the coasts of the Pacific became accessible to Russian investigators, the latter could only reach those regions situated at thousands of kilometers from the only scientific centre of those days, St. Petersburg, by means of the most primitive routes and wearisome journeys. Nevertheless, 36 years had hardly elapsed since the establishment of Russians in Kamchatka, when the adjunct of the Academy of Sciences Steller and the student Krasheninnikov, who both took great interest in the study of the vegetation of distant countries, were sent by the Academy of Sciences with the „Second Kamchatka Expedition". Steller was the first scientist who saw and studied the plants of the Alaskan coasts and those of the neighbouring islands, as well as of the Bering Islands, where he determined no less than 217 plants. Steller and Krasheninnikov explored Kamchatka and gave an account of the plants utilized by the natives.

Ever since that time the study of the vegetation of the northern coasts of the Pacific, although not without interruptions, has constituted one of the current problems of Russian science.

The naval expeditions of the beginning of the XIXth century, moreover, did not confine themselves to the study of the coasts, but extended their researches to the depths of the Ocean with their marine algae.

1. ALGAE OF THE PACIFIC OCEAN

F. Mertens, a botanist of the expedition on the ship „*Seniavin*" commanded by Th. Lütke in the years 1826—29, partly in collaboration with another naturalist of the same expedition, A. Pos-

tels, was the first to pay attention to marine algae, and by his extensive collections in the Bering Sea, gathered off the American and Asiatic coasts, he laid a foundation for the study of the algal flora. His collections' systematized by the Academician Ruprecht, have acquainted us with 104 species of *Phaeophyceae* and *Rhodophyceae*, containing not a few typical forms.

The first algae of the Okhotsk Sea from Ayan and Okhotsk were obtained by the Academy in 1807 from the adjunct Redovski, who prematurely perished. They were brought into system much later with those collected near the Shantar Islands by the Academician Middendorff, in the well known work of the above-mentioned Academician Ruprecht „Algae Ochotenses", in which are described and partly figured 57 species containing 26 *Rhodophyceae*, 20 *Phaeophyceae* and 11 *Chlorophyceae*.

The algae growing near the coasts of Kamchatka were first studied by Krasheninnikov and Steller and described by S. Gmelin in his „Historia Fucorum", 1768. Later, the naturalists of the Krusenstern, Kotzebue and Wrangel expeditions considerably enlarged the collections of algae from the Kamchatka coasts, and N. Voronikhin, in his work on the algae collected chiefly in the Avacha Bay by the botanist Savich of the Ryabushinski expedition, believes their general number to be 75. The hydrophytes of the Tartar Strait were investigated by F. Avgustinovich (1880) and F. Derbeck (1909). At the present time these algae are being systematized by Mrs E. Zinov, who is now, besides, preparing a scientific account of a series of algae from the coasts of the Primorski province, as well as of those of northern Sakhalin. In the current 1926 year Mrs Zinov has been collecting algae in Peter the Great Bay.

2. ALASKA AND THE NEIGHBOURING ISLANDS

In the year 1831 M. Bongard presented to the Academy his memoir on the vegetation of the Island of Sitka, founded on the collections of Mertens. Subsequent collections, obtained by merchants and officials of the Russian-American Company, were dealt with in the general revision of the Russian flora of that period by Ledebour. His „Flora Rossica", concluded in 1854, contains a considerable list of plants of the Alaskan coasts, as well as of the Aleut

Islands. An abstract from it was published by Rothrock in the yearly report of the Smithsonian Institution for 1867. Later on, Khlebnikov, Dr Tilling and Wahlrond made excursions on the islands of Sitka and Kodyak. The study of Alaskan plants, begun by Steller in 1741 (his work on the plants of cape St. Elias remained unpublished, and the manuscript is now in the possession of the Academy), was interrupted by the cession of that territory to the United States; but in 1914 a Russian traveller, A. Chechott, supplied the Petrograd Botanical Garden with a collection of plants from the river Yukon and the environs of the town of Nome. The collections of Mertens and others from the former Russian colony „Ross" in California have remained unpublished.

3. THE ASIATIC COASTS NORTH OF KAMCHATKA

The entire coast of the Bering Sea represents a tundra with a very poor vegetation, consisting of not above 300 species. The first information on the flora of Chukcheeland was obtained from Dr Merk, a member of the expedition of Billings and Sarychev in 1791.

Russian botanists never visited that coast, but plants were still brought from there by sailors (Skalovski, etc.) and officials (Borisov, Sokolnikov), who collected in Anadyr Bay and other places. Part of these plants were described by Trautvetter in the „Acta Horti Petropolitani" for the years 1876—79.

4. THE PENINSULA OF KAMCHATKA

The first plants collected in Kamchatka to the number of seven were described by Linnaeus in 1750; he was followed by Steller and Krasheninnikov, who mention about 60 Kamchatkan plants in their work. A series of plants from Kamchatka are figured in the „Flora Rossica" of P. Pallas.

In the XIXth century the investigation of the flora of that country was begun by the expedition of the ship „*Rurik*", a member of which, the botanist A. Chamisso, laid the foundation for the scientific study of the plants of Kamchatka. Mertens, naturalist of the ship „*Seniavin*", explored Avacha Bay and Karaga Island in 1828—29. P. Kuzmishchev published in 1836 his „Notes on the trees and shrubs of Kamchatka".

The learned horticulturist Rieder (1829—1831), an official in

the state service under the governor Golenishchev, travelled along the coast of the Shipun Cape as far as Lopatka, visited other parts of Kamchatka and collected about 450 species of plants. These collections and other data enabled Ledebour in his „Flora Rossica" to separate Kamchatka into an independant floristic province. The naturalist of the ship „*Seniavin*" Kittlitz and the geologist Dittmar supplied valuable information relating to the botanico-geographical features of Kamchatka; they characterized it as a country with a parklike landscape and covered principally with birch forests. Considerable collections were also made by physicians residing in Kamchatka: Levitski at Tigil (1844—54) and Dybovski (1879—83) in the valley of the river Kamchatka and other parts of the country: they formed considerable herbariums and added much to our knowledge of the Kamchatkan flora.

In the years 1908—09 the botanists of the Kamchatka expedition of Ryabushinski made a thorough study of the vegetation of that country. In the second volume of the Botanical Section of the results of the Ryabushinski expedition, issued in 1914 can be found accounts of the fresh water hydrophytes by A. Elenkin, the fungi by Bondartsev and Transchel, and the algae by Elenkin and Voronikhin. The publication of the „Flora of Kamchatka" was interrupted by the war, but in 1926 it was resumed by the Academy. Finally, specialists in forestry, Shilov and Henschel, in 1907 have studied the forests of Kamchatka and have made up their reports on this subject. The exploring party of the agriculturist V. Rubinski has studied the country with a view to its cultivation and gave a favorable report on that head. The flora of Kamchatka, poor in species (it contains a little over 700 vascular plants), is of great interest, owing to its connection with volcanic phenomena. Being sometimes heated from below or drenched by streams of hot water from above, buried in volcanic sand or completely destroyed by lava and other ejected matter, the plants of Kamchatka have remarkable biological peculiarities, rarely met with in other northern countries.

5. THE COMMANDER ISLANDS

The small group of the Commander Islands lying under 55°11′43″N lat. present considerable interest as affording a base for the inter-

change of plants between Asia and America. Since the time of Steller, who in 1741 had prepared a summary account of the Bering Islands plants, our knowledge of the Commander Islands' flora was enriched by the collections of Dr Dybovski (1879), Dobrotvorski (1881), Grebnitski (1894—1900) and, finally, of the geologist Morozevich (1903). All these collections were systematized by B. Fedchenko in his „Flore des Iles du Commandeur" (1906).

6. THE OKHOTSK PROVINCE

The western and northern coasts of the Okhotsk Sea lie in close proximity to the Stanovoy watershed. The southern parts of the latter are formed of several parallel mountain chains, while the northern represent the margin of a vast elevated plateau. The offshoots of these mountains reach the very coast, thus affording protection to some few larch forests. The Ayan flora, „Florula Ajanensis" by Regel and Tilling, issued in 1858 and containing information on 354 species, must be considered as a fundamental work for the study of the plants of this coast. Subsequently F. Sokolov, Podvoyski and others worked on the Okhotsk coast, but materials from still earlier periods are to be found in the Central Herbarium of Leningrad. Thus, in the year 1807 Redovski on his journey from the mouth of the river Uda to Gizhiga collected a considerable herbarium, which for a long time was erroneously taken for one from Kamchatka. In 1829 Wahlrond collected plants in the vicinity of Okhotsk; they are now preserved in the Central Botanical Garden, Leningrad. All the above-mentioned materials, as well as other of less important, give us a clear idea of the vegetation of the Okhotsk coast, a review of which is now on the eve of publication.

7. THE REGION FROM THE RIVER UDA TO THE AMUR VALLEY

On the 9th of June 1844, the Academician Middendorff on his way from Yakutsk reached Uda Fort; he then visited the Shantar Islands, Tugur Bay and the peninsula of Segneka with the mountain range of Ukurundu. His plant collections were described in 1856 by Trautvetter and Meyer in a series of works on the Middendorff expedition under the title of „Florula Ochotensis phaenogama", where we find an account of 371 plants. Another remarkable botanical expedition, though unconnected with the sea, was made by the

Academician Schmidt, who went from Nikolaevsk on the Amur by the river Amgun to the mountain range of Bureya and by crossing the mountains, reached the sources of the river Bureya. To this journey we owe our first information on the high mountain flora of these countries. The river Bureya, from its confluence with the Newman, leads to the region of the Amur, or rather Manchurian, flora; the investigation of the latter stands in close connection with the name of the Academician Maximowicz, to whose studies we shall now refer.

8. THE REGION OF THE RIVER AMUR AND THE NEIGHBOURING SEA COST

The 11th of July 1854, when Maximowicz landed on the coast of the De Castries Bay, is the beginning of an era in the history of botanical investigations. Not only did he accomplish much in this branch of science, but the greater part of subsequent investigators from Russia, as well as from Japan, more or less belong to the number of his pupils.

The first journey of Maximowicz was particulary rich in information regarding the flora of the valley of the Amur river between its mouth and that of its tributary Ussuri. He likewise explored the lower parts of the latter and the valley of the Amur up from Khabarovsk.

The journey was finished on the 8th of October 1856, and its results were published in 1859 in his classical „Primitiae Florae Amurensis", which contains strikingly exact and clear descriptions of plants and bright pictures of nature in its botanico-geographical part.

The second journey of Maximowicz began in 1859. He went down the Amur from its source to the mouth of the river Sungari; he then went 300 km up the latter, descended the same as far as the river Ussuri, which he likewise explored. In 1860 he passed from the banks of the Ussuri across the range Sikhota-Alin to the bays of Vladimir and Olga; then he went to port May (now Vladivostok) and visited the coasts of the bays of the Amur and Ussuri rivers, as well as Russian Island.

Maximowicz was the first to establish the characteristic traits of the Manchurian floristic region; he collected and studied more than 1200 of its species and gave a description of the forests

and meadows of the country. Apart from that, his methods of strict systematical exploration and his conception of the species as of a phenomenon of natural history give us a firm basis for future work.

Nearly at the same time as Maximowicz, R. Maack explored the banks of the Amur, going down the river as far as Mariinsk in the summer of 1855. In 1859 he visited the valley of the Ussuri and, first of all investigators, proceeded by the river Sungacha to lake Khanka. His plant collections, systematized by the Academician Ruprecht and A. Regel, are a valuable supplement to the work of K. Maximowicz. Further may be mentioned F. Schmidt (1859—62), G. Radde (1857—58) and N. Przewalski (1867—69), who visited the rivers Amur and Ussuri. In the years 1860—63 a systematical investigation of the forests had begun on the whole area between the valley of the lower reaches of the Amur and the limits of Korea, westwards as far as the river Ussuri and the boundaries of Chukcheeland. The results of this investigation were published by Budishchev, who was at the head of this expedition; his report demanded 3 editions. The same subject was subsequently dealt with by: Palchevski (1888—1903), a specialist in forestry, who, by the way, made a study of the fungous diseases of cultivated plants; Goldenstedt at Nikolsk Ussuriski (1871—80); M. Yankovski at Sidemi (1884), Avgustinovich at Vladivostok (1884), and others.

In 1891 the Academician S. Korzhinski explored the middle reaches of the Amur between Blagoveshchensk and Khabarovsk. His studies opened a new era of investigations connected with the agricultural colonisation of the Amur province; that country at that time attracted a continuous stream of emigrants from Ukraina and some other districts of Russia, which was caused by a comparative superfluity of the population in those days.

The results of this journey were published by S. Korzhinski in two papers; one of them, entitled „The Amur as an agricultural colony" had great practical importance bearing on the question of colonisation.

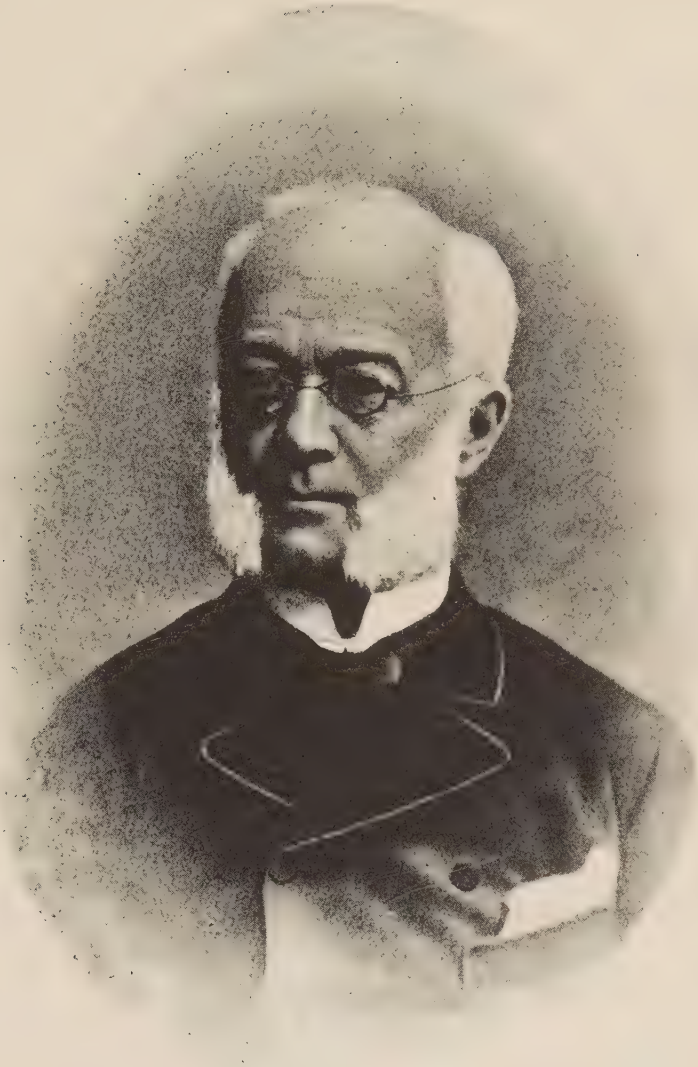
V. Komarov worked in the basin of the Amur in the years 1895 and 1896. He explored the area between the mouth of the Bureya and Khabarovsk by following the line of the then projected Amur railway. He then went from Nikolsk Ussuriski through Poltav-

skaya to Ninguta and from there through the town of Omosso to Girin. He published the results of this investigation in 1901—07 in his work „Flora of Manchuria", in which he had summed up all the information of former investigators, who had worked in the basin of the Amur and on the neighbouring coasts.

The town of Blagoveshchensk subsequently became the centre of local agricultural research. The Branches of the Geographical Society at Khabarovsk, Vladivostok and Nikolsk Ussuriski became centres for local investigators. N. Krylov and A. Cherski, energetic workers and members of the Vladivostok Branch of the Society, did much for the botanical exploration of the country. Moreover, the increasing tide of emigration led to the organisation of a series of botanico-pedological expeditions, at the head of which in 1908 stood K. Glinka and B. Fedchenko. To this series of expeditions to the Far East, belonged that of I. Kuznetsov to the Amgun, and to the ridge separating lake Bolon-ojal from the sources of the river Tunguska, or Kur; of Oettingen to the valley of the Amur below Khabarovsk; of B. Dokturovski to the tributaries of the Selemja and to the Tyrma rivers; of N. Prokhorov to the sources of the Zeya, to Gilui, and to the Tukuringra mountain chain, or in other words, to the north-western part of the Amur basin.

All these expeditions have supplied important botanico-geographical materials. In 1913 V. Komarov took part in these expeditions and travelled across the eastern part of lake Khanka, and parts of the Suifun and Suchan river basins. His materials are published in his work „Types of the vegetation of the southern Ussuri district", where we find information on 1402 species. Botanical researches are at present carried out simultaneously by N. Prokhorov and Mrs O. Kuzenev on the river Amur and by the Botanical cabinet of the Southern Ussuri Branch of the Geographical Society in the region of lake Khanka and of the river Suifun, which now continue to be explored by the energetic investigator Miss E. Alisov.

The University of Vladivostok has also its share in the botanical exploration of the country. Thus, in 1924 took place the expedition of V. Savich, who explored the forests along the river Kep in collaboration with I. Shishkin, the investigator of the forests on the neighbouring river Bocha. I. Shishkin had formerly



L. SCHRENCK
(born April 24, 1826, died January 8, 1894)

taken part in the work organized by the South-Ussuri Branch of the Geographical Society. He had conducted the Suchan expedition, which proved rich in results and had studied, by the way, the alpine flora, left unexplored by former investigators.

The Manchurian part of the Amur basin forms the object of the study of the „Society for the Investigation of Manchuria" at Kharbin; B. Skvorzov of that Society very eagerly collects and systematizes his collections, paying particular attention to the inferior algae of the river Sungari and also to the cultivated plants of Manchuria.

9. KOREA

The first plants of Korea, altough not a numerous collection, were obtained in 1854 by A. Schlippenbach, who made a voyage on the frigate „*Pallas*"; subsequently a number of English investigators, as also Kalinovski in 1886, A. Bunge in 1889, N. Epov in the same year, collected plants in Korea, while A. Sontag explored the environs of Seul. All these collections were systematized by I. Palibin in his „Conspectus Florae Koreae" containing information on 644 plants and which was issued by the Central Botanical Garden of Russia in 1898—1901.

On the 11th of May 1897, V. Komarov crossed the frontier of Korea near the base of the river Tumyn-gan delta and, passing the towns of Kherieng and Mussang, penetrated to the mountain-pass Abuzza-Kogar, which leads to the upper reaches of the river Amnok-gan, better known under the Chinese name of Yalu; then, proceeding partly through the valleys of the left affluents of the river, partly along the valley of the river itself, he descended to the mouth of the river Hudju-ubi. The botanical results of this journey were incorporated in his general work on „The Flora of Manchuria", as this part of Korea has, on the whole, the same flora as the neighbouring Manchuria.

Finally, a considerable number of plants were likewise collected in Korea during the zoological expedition of P. Schmidt in 1900, chiefly between Genzan and Seul.

10. THE ISLAND OF SAKHALIN

In the work of Maximowicz „Primitiae Florae Amurensis" we already find a description of 27 species of plants of Sakhalin. But

the actual investigators of this island were F. Schmidt and his fellow traveller P. Glehn (1860—61), who made excursions almost throughout the whole island and ascertained the composition of its flora, as well as its leading botanico-geographical traits.

The results of their work, to which were added the plants of Sakhalin, collected by I. Lopatin (1868), Avgustinovich (1871—72) and the agronomist Mitsul (1871—72) are published in the „Records of the Siberian Expedition of the Russian Geographical Society", vol. II, in 1874. This work contains information relating to 608 plants.

Subsequently other investigators, who visited Sakhalin, made some additions to this standard work on the flora of the island. Thus, the ethnographer Sternberg made an interesting collection of plants from Cape Elisabeth, the northernmost extremity of the island. The agronomist M. Semiagin published in the „Contributions to the investigation of the colonisation regions of Asiatic Russia" a work entitled „A description of the Flora of the Okhotsk coast of the Sakhalin Island" (1911) as a result of his explorations of that coast in the year 1909. In this work we not only find a description of the flora, but also an account of the agricultural regions of the island in connection with its soil and vegetation.

The agronomist E. Bezays published in 1909 a short account of the flora of central Sakhalin, in which he emphasizes the contrast between the western and the eastern coasts of the island.

11. JAPAN

Many eminent scientists of Japan are now exploring the flora of their country, but in the year 1860 that work had hardly begun. Thus, the Academician Maximowicz, who in the autumn of 1860 visited Hakkodate, one of the few points in Japan then accessible to foreigners, was one of the pioneers in the matter of the investigation of that country.

The year 1862 he spent at Yokohama and that of 1863 at Nagasaki. Being restricted in his travels to an area with a radius of 40 kilometers, he would obviously never have been able to enlarge his investigations, had not his numerous friends among the Japanese assisted him in that matter. Since long taking a lively interest in the cultivation of their native plants and having acquired a perfect

knowledge in distinguishing their forms, they viewed the work of K. Maximowicz with great sympathy and brought him many plants with exact information as to the places where they grew. Among these friends Tschonoski, Tanaka and others may be mentioned.

Maximowicz has not left us a full description of the plants collected in Japan, but he has issued a series of monographs on various groups of plants, in which he has revised in a masterly manner, towards a proper and full comprehension of the subject, all the information to which he had access at that time.

The great accuracy of his treatment of the subject introduced into the investigation of the Japanese flora the true scientific spirit, so desirable in the study of Nature.

Besides Maximowicz, the physician of the Russian consulate Dr Albrecht collected plants in the vicinity of Hakkodate; some plants were obtained by sailors who visited Japan. The botanist Kosinski, too, gathered a collection of Japanese ferns.

The rich herbarium of Maximowicz in its totality, as also his handwritten notes and drawings, is now in the possession of the Central Botanical Garden of the URSS, where it constitutes the nucleus of the Herbarium of Eastern and Central Asia.

12. CHINA

The chief contributions of Russian scientists to the study of China's flora were the expeditions of G. Potanin to the provinces of Kansu and Szechuan, organised by the Russian Geographical Society. In the first, 1884—85, the southern part of Kansu with its remarkable tuff valley Xernzo was explored and the gradual transition from the continental and comparatively xerophytic flora of Amdo, as yet forming a part of the table-land of Tibet, to the luxurious vegetation of the Pacific province of Asia was studied. Sun-pan-ting in Szechuan with its magnificent coniferous forests was also traversed by this expedition.

The second Chinese expedition of G. Potanin took place in 1893. He then visited the celebrated mountain O-mi-shan, the environs of Da-dsian-lu, etc., on the boundaries of the table-land of Tibet, and brought home truly magnificent collections, which were partly systematized by A. Batalin (A. Batalin „No-

tae de plantis asiaticis" in the „Acta Horti Petropolitani" 1891 — 1895) and by Maximowicz (K. Maximowicz „Plantae Chinenses Potaninianae, nec non Piasezkianae", Acta H. P., 1890).

Although the investigation of China's flora is now making such great progress, the above mentioned works still retain their importance, owing to the large number of the species described.

We have also to mention here the work of the physician of the Russian Mission at Peking, Dr Bretschneider, who has written an excellent history of the botanical investigation of China.

15. SUMMARY

The above-mentioned investigations of Russian men of science in great part bear the character of pioneer work. As regards Alaska their investigations for obvious reasons could not be continued.

In Japan, on the contrary, the studies of Maximowicz cannot be regarded as constituting but a superficial review of the botanical resources of the country, but rather as the laying down of a stable basis for the work of scientifically building up the whole Japanese Flora.

In Korea, which can now boast of the splendid work of Nakai, the importance of our studies has considerably diminished, although there still remains much matter based on facts that has not lost its value in spite of Nakai.

The same may be said of China.

On the other hand, in regions, where Russian investigators are still continuing their work, the latter is progressing slowly, perhaps, but perseveringly, and affords us the means of drawing scientific deductions, as well as applying them to practical needs.

The study of the vegetation of the northern coasts ot the Pacific Ocean brings forward the problem of a scheme for the international protection of the mountain forests and measures for regulating their exploitation. In all the countries bordering on the Pacific, with the exception of Japan, forests are being completely destroyed; in these countries the soil is washed away by the rain and becomes subject to landslides and drifting, which prevents the restoration of the timber. The measures for ensuring the proper utilization of forests and their renovation after cutting and destruction by fire would be profitable not only to the countries immediately concerned, but to all the nations that inhabit the shores of the grandest seawater basin in the World.

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Zoology

by P. Schmidt

We owe our first knowledge of the animals of the North Pacific to the Russian naturalists G. W. Steller, adjunct of the Academy of Sciences, and Stephan Krasheninnikov, a student of that Academy, who took part in the second Kamchatka expedition under Vitus Bering (1733—43). G. W. Steller was without doubt one of the most talented and scientifically educated naturalists of his time. Zealously devoted to science, in spite of the most adverse conditions of work, he was fully engaged in various observations during this expedition, which came to such a tragic end. The diary of his journey (1793) contains many very valuable observations relating to various sea and land animals of Kamchatka and of the islands near the North-American coast. In his „Topographical and physical description of Bering Island" (1781) he gives a most complete description of the nature of the island and of its remarkable fauna. From these studies we are made acquainted for the first time with the life of fur-seals, sea-otters and sea-cows, described in still greater detail in his treatise „De bestiis marinis" (1751).

To the great loss of science, Steller died on his way back to Russia in 1746 and only few of his observations were published after his death. Some of his descriptions of different fishes and other animals were utilized later by Pallas and Tilesius.

The pupil and companion of Steller, Stephan Krascheninnikov, in his celebrated book „Description of the land of Kamchatka" (1755) allots sufficient space to the description of different useful fishes and other animals.

Of the important expeditions, that have taken place in the XVIIIth century, that of captain J. Billings (1785—93) is of parti-

cular value for the study of the fauna of the Pacific. J. Billings was accompanied in that expedition by the naturalist Dr Merk, who made large collections of different sea animals, which were later described by P. Pallas in several separate notes and in his „Zoographia Rosso-Asiatica" (1811—31).

In the beginning of the XIXth century our knowledge of the fauna of the Pacific Ocean was considerably enriched by Tilesius and Langsdorff, naturalists of Krusenstern's expedition (1803—06), which was the first to circumnavigate the globe under the Russian flag. Tilesius during this expedition made large collections and produced a number of valuable papers on fishes, molluscs and various other marine animals of the Pacific, many of which are very well described and figured in the „Atlas" of the expedition. The descriptions of Tilesius are remarkably exact and have not yet lost their value.

Langsdorff, the second companion of Krusenstern, gave some very precious notes on the fauna in his description of the voyage; his article on Kamchatka contains also various observations relating to fishes and fisheries.

In the begnining of the XIXth century an attempt was made by P. Pallas to incorporate in one special treatise, the abovementioned „Zoographia Rosso-Asiatica", all that was known of the fauna of Russia, including the northern part of the Pacific Ocean. The third volume of this work was published after the premature death of that famous naturalist and encyclopedist by G. Tilesius. In this remarkable work, which has not yet lost its value, were summarized all the most important zoological discoveries of Steller and Tilesius, among which we find descriptions of 81 different species of fishes of the North Pacific Ocean, as well as of many species of mammals and birds of the Pacific coasts.

In the first half of the XIXth century our knowledge of the fauna of the North Pacific was enlarged by two expeditions of Kotzebue on the ships „*Rurik*" (1815—18) and „*Predpriatie*" (1823—26). During the first journey Kotzebue was accompanied by the German poet and naturalist Chamisso and by Dr Eschscholtz; it was during this expedition that the famous discovery by Chamisso of the alternation of generations of *Salpa* took place.

On the second expedition Eschscholtz observed and, accord-

ing to his own words, partly collected 2400 forms of animals, most of which belonged to the fauna of the North Pacific and of the Bering Sea. Many of them were described and illustrated in his „Zoological Atlas" and in his monograph of the *Acalephae*.

Almost at the same time, in 1826—29, the Okhotsk and Bering Seas were being explored by the hydrographical expedition of Lütke, in which Dr Mertens took part as a zoologist, V. Kittliz as an ornithologist and A. Postels as a geologist. Mertens made some most interesting collections of invertebrate animals, but unfortunately the untimely death of this talented man, most devoted to his work, did not enable him to bring his work to a conclusion. V. Kittliz made a number of most interesting ornithological observations and prepared a list of all the zoological materials that were collected by the expedition. A considerable part of these collections was later systematized and published by J. Brandt.

Here should also be noted the remarkable work of a little known and modest devotee of science E. Voznesenski, a preparator of the Zoological Museum, who was sent by the Academy in 1839 to the Russian-American colonies to make some collections for that Museum. He made excursions in Alaska and North California, on the Aleutian, Pribylov, Commander and Kuril Islands and on the coast of the Okhotsk Sea throughout a period of 10 years, and, notwithstanding the most adverse conditions of work, he made very large collections of land and sea animals of quite exceptional value. These collections have for many years served as material for the studies of members of the Russian Academy of Sciences, such as Brandt, Grube, Middendorff and others.

On the Commander Islands Voznesenski obtained numerous remains of the extinct sea-cow, which were subsequently made use of by J. F. Brandt for a series of scientific papers. Among these remains was obtained an entire skeleton of this animal, which is now preserved in the Zoological Museum of the Academy of Sciences, as also a piece of its skin and its horny rasp, which replaces the teeth.

The first period of zoological investigations ends with the work of Voznesenski; these investigations were chiefly made from board ship by naturalists, that took part in naval expeditions sent to explore new countries. In the middle of the XIXth century the coasts of the Pacific Ocean begin to attract an increasing stream of

emigrants from Russia, and this circumstance both strengthened the interest felt towards the new country just beginning to be colonized, and considerably smoothed the difficulties for explorers. Subsequent scientific expeditions acquired a new character by seeking aims requiring more detailed research.

The natural conditions of the north-eastern parts of Siberia were thoroughly investigated by the expedition of the member of the Academy of Sciences A. Middendorff, which lasted 4 years (1842—45). Travelling at first on the Yenisei, he reached the Taimyr Peninsula, and then went to the coast of the Okhotsk Sea, visiting on his way Yakutsk and Aldan. On the Okhotsk Sea, in a small leather boat made by himself, he reached the Shantar Islands and Tugur Bay. During his short stay an the coast of the Okhotsk Sea he made some valuable collections of molluscs and other sea animals, on which his further studies were based; they were the first to give us a proper idea of the nature of this sea and of its purely arctic character. His study of the molluscs of the Okhotsk Sea (1851) must still be considered as the only source of our knowledge of the malacology of this sea. The richest collections, gathered by Middendorff, of mammals, birds and reptiles, were systematized and published by himself and gave for the first time a more exact idea of the character of the fauna of the north-east of Siberia. His collections of *Echinodermata, Crustacea* and worms of the Okhotsk Sea were studied by Brandt, Grube and Fischer, and his valuable collections of insects by Ménétrier and Erichson. The reports published by these specialists contain completely new and highly interesting matter. Middendorff not only systematized his own collections, but likewise drew a number of important zoogeographical inferences that have set in its proper light the general character of the arctic and subarctic fauna.

Other important scientific expeditions to the coasts of the Pacific continued from 1853 to 1860 the work that was begun by Middendorff. The richest results were afforded by the expedition of L. Schrenck, a member of the Academy of Sciences (1853—57); he chiefiy dealt with the coasts of the North Japan Sea and Sakhalin and undertook a journey down the Amur river. Collections made by him were most extensive and various. He paid great interest (in which he followed Middendorff) to all kinds of sea animals, primarily to

molluscs; his studies enabled him to ascertain the character of the malacological fauna of the North Japan Sea, as well as its relationship with the faunas of the neighbouring regions of the Pacific.

The studies of Schrenck on the molluscs of the Japan Sea (1867) must be still considered to be the only and most valuable source of information on that subject. He subsequently systematized his own collections of mammals and birds, and this work of his may be regarded as a most fundamental and important contribution to science, acquainting us for the first time with all the interesting features of the fauna of that region.

In 1855—57 scientific work was the object of the expedition of G. Radde, chiefly in Transbaikalia and Dauria; Radde, however, extended his travels by descending the Amur to the mouth of the Ussuri river and made a detailed study of the fauna of the vertebrate animals of the entire country. His work may be considered as a very valuable supplement to the studies of Middendorff and Schrenck; it enlarged our knowledge of the distribution of all kinds of animals beyond our Pacific passessions towards the south and west. Radde was also the first to give a zoogeographical map of the entire region of the Amur river and its tributaries.

Almost at the same time two expeditions of R. Maack went down the Amur (1855) and the Ussuri rivers (1859). They considerably enriched our knowledge of the fauna of the Ussuri region, which theretofore was practically unknown. Maack, besides very valuable collections of vertebrate animals, made some very rich collections of insects.

The so called „Siberian" expedition of the Russian Geographical Society under the leadership of F. Schmidt and P. Glehn attained most valuable results, relating to the geology and botany of Sakhalin and Amurland, but brought comparatively few new zoological facts. The same may be said of the expedition of K. von Dittmar (1851—55) in Kamchatka, whose contribution to zoology was restricted to a detailed study of fishes and fisheries and of fur animals.

With these expeditions ends the second period of expeditions organized on a large scale. It was followed by a period of inactivity as regards the further investigation of the fauna of the coasts of the Pacific. The principal scientific centres of Russia were then engaged

in other problems; while local scientific bodies were as yet too insignificant to be able to organize expeditions.

Here is the place, however, to note the exceptional activity of B. Dybovski in the prosecution of scientific studies, who gathered considerable collections in Amurland and in Kamchatka and published the first list of the fishes of the Amur (1877).

It was not before 1880 that a kind of revival of interest in further scientific investigations may be percieved.

In 1881—82 the expedition of the zoologists J. Poliakov and A. Nikolski undertakes the exploration of the fauna of Sakhalin and collects very interesting material. After the death of Poliakov, this material was brought into order by Nikolski; his work on the fauna of the island of Sakhalin (1889) must be regarded as very valuable: it gives a general idea of the character of the fauna of this island and of its relations to the faunas of the neighbouring regions. This fauna seems to be connected chiefly with the Siberian and has only very distant relations with the fauna of the Japanese Islands.

In 1884 Th. Pleske made several collections of fishes in the valley of the lake Khanka. This collection was systematized by N. Varpakhovski and S. Herzenstein (1887).

In 1884 appears the first scientific centre on the Russian coasts of the Pacific, the „Society for the Study of the Amurland" at Vladivostok. It founds its own museum and begins to issue its „Memoirs", in which appear various observations on the country and on its nature, containing very often most valuable scientific material. The foundation of the Vladivostok Museum, comprising a fairly rich library, was the means of bringing together people interested in nature and science, and of promoting local research, but owing to lack of specialists, scientific progress was slow.

Ten years later, in 1894, a second scientific centre arose on the Amur in the new town of Khabarovsk, the „Amur Section of the Russian Geographical Society". This Section also takes an active part in the exploration of the Amur district and has laid the foundation of a second museum, that of Khabarovsk, which is likewise becoming a centre of attraction for people interested in the study of nature and the country.

The contribution of these two Societies to the investigation of the

country was and continues to be very considerable. They represent local bases for various expeditions, arriving from the centre, besides which they have frequently organized scientific investigations and expeditions, and published various materials and observations. In their publications a quantity of most interesting matter may be found which, without their cooperation, would most certainly have been lost to science.

Subsequent zoological investigations have generally acquired the tendency of exploring more restricted territories: it would therefore be more convenient in dealing with them to pass them in review in the order of the different regions explored.

The investigations of the marine fauna and that of the Bering Sea will be first considered.

Russian travellers and naturalists were here first attracted by the Commander Islands with their rich natural resources in fur-seals, sea-otters and arctic foxes. The first information on the fur-seals and their life, given by Steller, was subsequently much enlarged by the observations of the Russian missionary Innocent Veniaminov, afterwards Metropolitan of Moscow (1840). Some observations have been made by Dr B. Dybovski during his various visits between 1879 and 1883, by N. Grebnitski (1882) and Dr N. Slunin (1896). Recently the Commander Islands have been visited in 1910 and 1911 by E. Suvorov, who gave in his book (1912) a detailed survey of the nature of the islands, the condition of their population, the life of fur-seals and the state of the fur-seal industry.

No kind of scientific investigation of the fauna in the western part of the Bering Sea has yet been undertaken, and the only materials that illustrate the character of the marine fauna of this region have been collected by the Hydrographical Expedition on the Pacific Ocean, of which mention will be found below.

On the Okhotsk Sea we have some very important investigations of V. Brazhnikov and V. Soldatov, undertaken by the Department of Agriculture. V. Brazhnikov studied the hydrology, fauna and fisheries of the estuary of the Amur and undertook several excursions in the Sakhalin Bay and along the eastern coast of that island (1896—1902). In his two accounts (1900, 1904) he gave a most interesting summary of considerable scientific value concerning the topographical, hydrological and zoological conditions of the estuary

of the Amur river, in connection with the biological peculiarities of fishes and the distribution of fisheries. His work published later on the *Crustacea Decapoda* of the Okhotsk Sea (1907) ascertains the systematical character of the fauna and the distribution of the group mentioned in the Okhotsk and North Japan Seas.

V. Soldatov undertook scientific investigations in the lower parts of the estuary of the Amur, as also in the Okhotsk and North Japan Seas from 1907 till 1913, and has gathered most valuable information on the fauna and the biology of these seas. His study on the biology of salmons (1912) gives for the first time a sufficiently clear idea of the migration of these fishes in the lower parts of the Amur, based on detailed observations and numerous measurements. His work on the Amur sturgeons (1915) contains not only detailed descriptions of the fishes of this family, based on a large number of observations and measurements, but also their full biology. The very large collections of fishes, made by himself and by his assistants, as well as by other naturalists of the Department of Agriculture (Smirnov, Begak, Heinemann, Pavlenko) are being now systematized by himself and by specialists of the Zoological Museum of the Academy of Sciences.

The North Japan Sea in 1900—01 was explored by the expedition of P. Schmidt, which was organized by the Russian Geographical Society. This expedition studied the marine fauna of Peter the Great Bay (south Sakhalin) and of the west coast of Sakhalin, near Mauka. Large collections of fishes and other marine animals were also made in Japan and in Korea. The fisheries of the southern part of Sakhalin (1905), which then belonged to Russia, were examined and described by this expedition. In his work „The fishes of the Eastern Seas" P. Schmidt (1904) gives a revision of a collection of fishes, made by himself, and of the collections of his predecessors (144 species of fishes altogether) and makes the first attempt to characterize from a zoogeographical point of view the three seas: Bering, Okhotsk and Japan. These seas have very much in common in their natural conditions and contain a fauna, that exhibits a rather close relationship between them.

The Bering Sea should be divided into a northern and a southern part; the North Bering Sea contains an arctic ichtyofauna, which resembles that of the Arctic Ocean, but is richer in species; the

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(born November 11, 1827, died February 4, 1891)

South Bering Sea, being under the influence of the warm current of Kuro-Shiwo, contains a fauna of a rather mixed character, which is considered to belong to the subarctic region.

The Okhotsk Sea, which is withdrawn from the influence of the warm current, is subject to a very severe climate and during a considerable part of the year is covered, particularly in its northern part, with floating ice and resembles in its temperatures the Arctic Ocean. With the exception of its southern part, it contains an arctic fauna with its most typical fish representatives, such as species of *Icelus*, *Triglops*, *Artediellus*, *Careproctus*, *Lycodes*, *Aspidophoroides*, and others.

The Japan Sea, owing to the current of Kuro-Shiwo, a branch of which enters the sea from the south as the Tsushima current, presents very complicated conditions. From a faunistic point of view it ought to be divided into two parts: the North and the South Japan Seas. Into the northern part penetrate by way of the Nevelskoi Strait (or Tartary Strait) many arctic forms of the Okhotsk and Bering Seas, whereas the southern part, owing to the Tsushima current, receives many tropical forms, which in its southernmost part, near Fusan, give a subtropical character to the fauna. The fauna of the North Japan Sea contains arctic forms, such as „vakhnya" (*Eleginus navaga* subsp. *gracilis* Til.), that reaches Vladivostok and is very closely related to the „navaga" (*Eleginus navaga* Kölr.) of the White and the Kara Seas, and different species of arctic *Cottidae*, *Agonidae*, *Liparididae*, etc. This fauna must therefore be considered to be subarctic. But a quantity of southern forms penetrate also into the North Japan Sea and are even found near Vladivostok, — mostly pelagic fishes, such as mackerels, Japanese species of herring, *Plectognathi*, etc.

On comparing the west and the east coasts of the Pacific from the zoogeographical point of view, it may be seen, that on the coasts of Asia the arctic and subarctic fauna descends very far to the south, and arctic fishes can be met with under 42—43° N lat., whereas on the American coasts they are repulsed by the warm current and driven far away to the north, giving place to a wide development of the fauna of the temperate region.

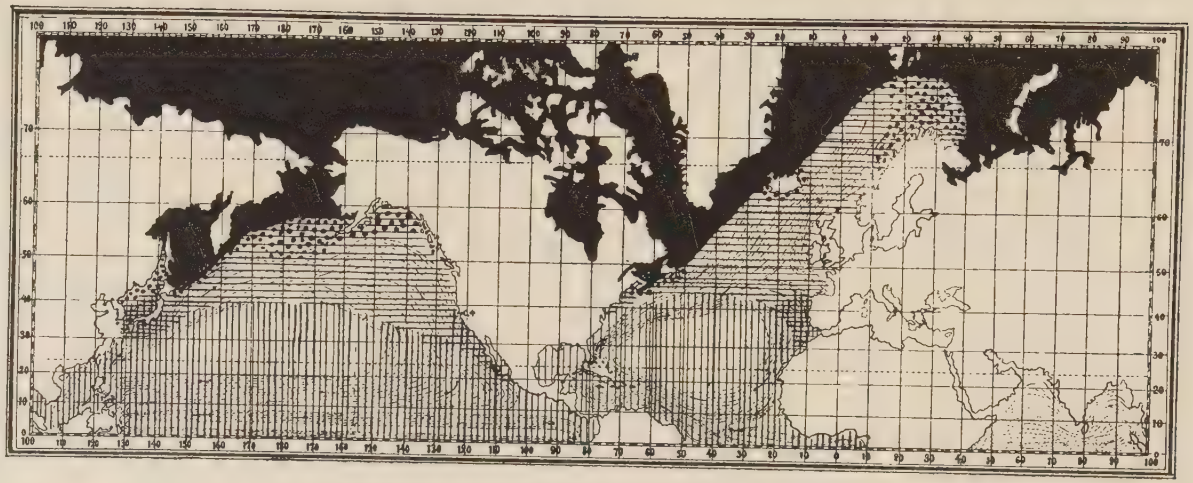
In comparing the corresponding zoogeographical regions of the Pacific with those of the Atlantic Ocean, it appears that on the American coast of the Atlantic the arctic and the subarctic faunas may also be encountered far away to the south, almost at 42° N lat., off

cape Cod, whereas on the eastern coasts of that ocean the southern limits of the subarctic and the arctic regions are removed by the Gulf-stream to as far north as the northern parts of Norway, the Murman coast and Novaya Zemlya. On the west, near cape Cod, we find the same blending together of the zoogeographical regions as in the Pacific.

A comparison of the corresponding parts of the North Pacific and of the North Atlantic Ocean exhibits, besides, other remarkable peculiarities. The fauna of the arctic and subarctic regions of both oceans are in rather close relationship, but the Pacific fauna appears to be much richer than that of the Atlantic Ocean, and it can be said, that they correlate in the same way as the fauna of the North Sea with that of the Baltic. The two oceans contain several species of fishes identical in both, as, for instance, the Pacific cod and the Pacific herring, which after our investigations are the same species as those of the Atlantic. At the same time many genera of fishes represented by various but nearly related species occur in both oceans. But in this latter case the Pacific genera contain generally numerous species, whereas the Atlantic have but one or two, closely related to the Pacific forms. Contrary cases are very rare. Lastly, the Pacific Ocean contains many genera and even several families of fishes, not found in the Atlantic.

Correlations of such kind cannot be explained by the conditions of the present day; the explanation must be sought in the distinct geological histories of the two oceans. It may be suggested, that in recent geological periods the two oceans were connected by a wide channel in the place of the Isthmus of Panama. According to modern geological investigations they communicated also in the Pleistocene period by means of the Bering Strait and must have had a more or less identical fauna, owing to the resemblance in their physical conditions. But at the time of the ice-age the fate of both oceans was not the same: whereas the Atlantic Ocean, being quite open from the north, and containing on both coasts largely developed glaciers, was subject to strong cooling by the floating ice that descended very far to the south, the Pacific Ocean was spared this lot: glaciers were inconsiderably developed along its American coasts, and wanting on its Asiatic side. Therefore, the fauna of the Pacific retains at present time its more or less primitive state, whereas the Atlantic fauna has become poorer and has lost many of its forms.

ZOOGEOGRAPHICAL REGIONS OF THE NORTHERN PACIFIC AND NORTH ATLANTIC OCEANS AFTER THE DISTRIBUTION OF FISHES (BY P. SCHMIDT)



Arctic region. Temperate region. Tropical region.

Subarctic region. Subtropical region.

In this respect the fauna of the Pacific Ocean forms a complete parallel to the land fauna and flora of Japan and of the Amur region. We must regard the present fauna of the North Pacific Ocean as being more closely related to the fauna of the end of the Tertiary epoch. This greatly increases the interest presented by the study of the Pacific fauna in general.

The ichthyofauna of Peter the Great Bay was studied later by M. Pavlenko (1900), who published also a special work on the herring and herring fisheries at Vladivostok (1914). Large collections of vertebrate and invertebrate animals of this bay are preserved in the Museum of the „Society for the Study of Amurland" at Vladivostok.

Many collections of the North Japan Sea were received by the Zoological Museum of the Academy of Sciences (Leningrad) and were studied by specialists. The ascidians of this sea were studied by V. Redikortsev (1911), A. Ostroumov and M. Pavlenko (1911), the holothurians—by M. Britten (1907), the Pantopoda—by V. Shimkevich.

The most valuable scientific material for the fauna of the Bering, Okhotsk and Japan Seas is represented by the collections, that were made by naval surgeons of the ships of the Russian Navy. Pioneers of this work were Drs N. Sliunin and A. Isaiev; they made in the end of the XIXth century large collections of marine fauna during the cruises of the ships of the Russian fleet. The ships of the Hydrographical Expedition, engaged in surveying the coasts, had many opportunities to conduct zoological investigations. The zoological collections of the Japan, Okhotsk and Bering Seas made by Dr F. A. Derbek in 1908, 1909, 1910 and 1912, Dr L. Starokodomski in 1912, Dr N. Shiriaiev in 1913, Dr G. Meder in 1914, 1915, 1916 and 1918, Dr Semenov in 1919 and Dr A. Pokrovski in 1920 are of particular value from the scientific point of view. They are now being studied, and the results are being partly published by the specialists of the Zoological Museum of the Academy of Sciences of the USSR.

An event of considerable importance in the scientific life of the Far East is the foundation in 1925 of the Marine Biological Station at Vladivostok. The idea of organising such a scientific institution belongs to the „Society for the Study of the Amurland", an attempt

to establish which had been already made in 1900. The lack of specialists, however, as well as an absence of the necessary funds did not then permit this idea to be realised. At the present time, with the foundation of the University of Vladivostok, a group of specialists, interested in the exploration of marine life, has appeared. The utility and the necessity of a scientific institution of this kind for the development of fisheries and of the fish industry is fully recognized by the authorities of the Far East Republic, and thus it may now be assured of being established on a solid basis. It is to be hoped that the Marine Biological Station of Vladivostok, not having yet passed the preliminary stages of organisation, will soon begin a new fruitful era in the history of the exploration of the western part of the Pacific.

We may say that Russian naturalists have spent much energy in exploring the fauna of the Pacific Ocean. And it must be noted, that all their investigations were carried out under most difficult conditions. Russian naturalists could not possess ships of their own, and the vessels, that had been provided for them, were not sufficiently well equipped for scientific work. That is the reason why one of the most interesting and attractive problems — the exploration of the depths of the Japan and Okhotsk Seas—could not yet be attacked. Meanwhile, these seas possess true bathybial depths of 1500—1800 fathoms and they, without doubt, contain a most interesting and nearly unknown fauna.

In treating now of the exploration of the land fauna on the coasts of the North Pacific, we see that at the extreme north-east the Chukchan Peninsula is but little investigated. We posses rather scanty information on the mammals and birds of this vast, but very inhospitable country. The fauna of fishes in its rivers is also little investigated. The scientific investigation of the Chukchan Peninsula forms one of the first problems of the future.

Kamchatka from the zoological point of view is more fully investigated. In 1908—1909 the Kamchatkan expedition of the Russian Geographical Society, organised by Riabushinski, was exploring that country. The zoological section of this expedition was under the guidance of P. Schmidt; Dr V. Bianchi as ornithologist A. Derzhavin as hydrobiologist and N. Lebedev, as hydrologist have taken part in the expedition. The investigations of this section embraced the neighbourhood of Petropavlovsk and the valley of the Kamchatka river. It made a detailed exploration of the estuary of the

Kamchatka river and of the Nerpichye lake, as well as of the entire course of the river up to its source. The expedition also visited the Kronotskoye lake, which was until then quite unknown. A visit was paid to the most interesting lake of Kurilskoye, which was surveyed in the winter. Hydrological investigations of several lakes were undertaken near Petropavlovsk. Large zoological collections made by the expedition during one and a half year of its work in Kamchatka, containing materials relating not only to mammals, birds and fishes, but also to insects, arachnids, worms and representatives of the fresh water fauna, have been partly systematized and published. The death of Riabushinski in 1909 and the subsequent years of war and revolution have delayed the publication of other materials of this expedition.

The results obtained at the present time show, that the fauna of Kamchatka is in close relationship with that of Siberia, revealing some slight connection with that of North America. At the same time it must be noted that the fauna of this country bears the character of an island fauna. This is demonstrated by the absence of some species of animals, that should have been living there, had Kamchatka been for ever an indissoluble part of the continent of Asia. Thus among the mammals of Kamchatka we do not find squirrels, lynxes, elks, hedge-hogs, moles and badgers, which are widely spread all over Siberia, whereas they might have been living there so far as the natural conditions are concerned. Reptiles are quite absent, as well as amphibians, with the exception of *Salamandrella keyserlingii* Dyb. Most remarkable is the absence of fishes in the rivers of Kamchatka, with the exception of salmons, that come up from the sea, as well as of sticklebacks and lampreys. The absence of *Cyprinidae* in the rivers indicates that the streams of Kamchatka were not connected with the Siberian rivers,—they were populated directly from the sea. All these observations suggest, that Kamchatka was formerly an island—the last in the chain of volcanic islands, which surrounds the continent of Asia.

The Amur and the Ussuri districts, owing to their large extent, richness and diversity of fauna, cannot be considered to be well studied from the zoological point of view in spite of many scientific explorations undertaken by Russian zoologists. Of all faunistic studies, concerning the Amur district should be especially noted the work on the Amur fishes by L. Berg (1909), which gives an exact idea of

the general character of the ichthyofauna of that country. In this treatise L. Berg gives special prominence to the richness of the Amur fish fauna: up to the present time we know 72 species of fishes, whereas all the rivers of Siberia contain only 62 species, and the whole European part of the USSR — 95. The composition of the fauna is as follows:

	Genera	Species
In common with the European part of the USSR. .	22	18
„ „ „ Siberia	22	23
„ „ „ China	36	34—36
„ „ „ Japan	26	21 (11— migratory species)

Thus Chinese genera and species predominate in the fish fauna of Amur, whereas the European and Siberian are comparatively scarce. We meet with only 16 endemic species that are proper to the Amur alone, which makes 22% of the fauna, while only a single endemic genus is found. Berg, therefore, considers the fauna of the Amur and its tributaries to be a transitional region between the circumpolar subregion of the holarctic region and the Chinese subregion of the Sino-Indian region, and the representatives of the latter predominate.

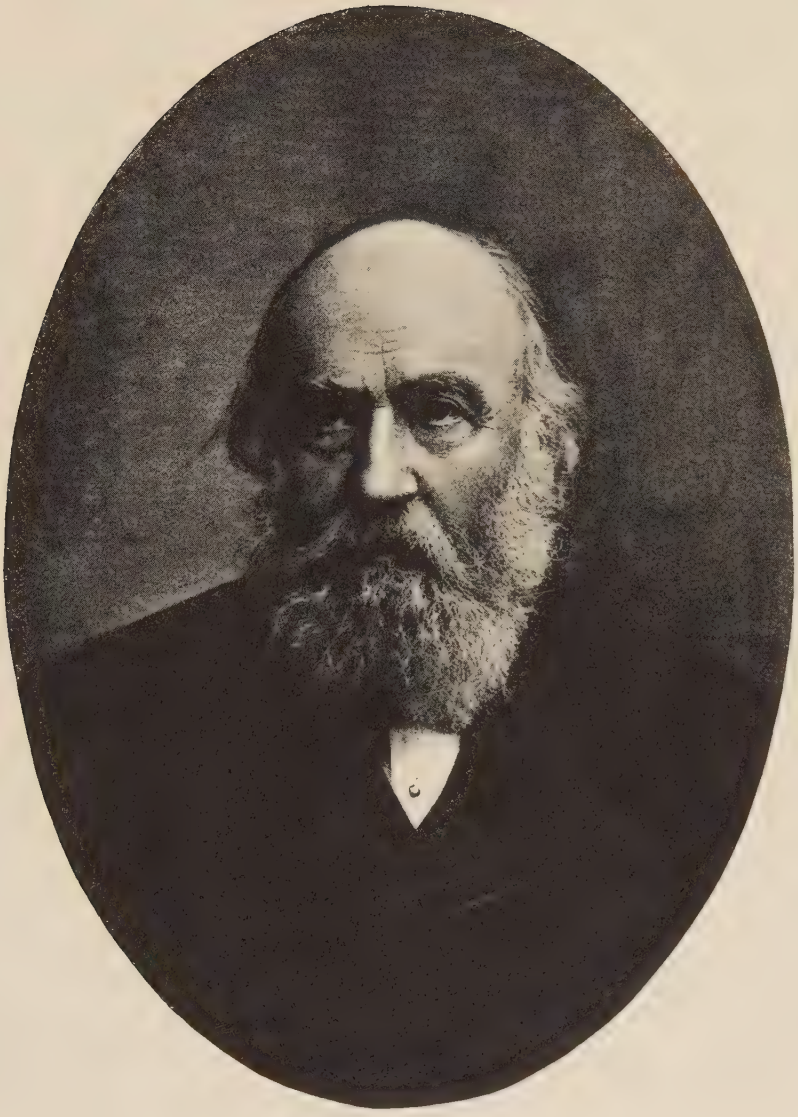
A close examination of the fish fauna of the Amur show us that it contains some species, that have their relatives and even identical forms in the European part of the USSR and in Western Europe; these, however, are not found in Siberia. Thus, for instance, the big Amur sturgeon „kaluga" (*Huso dauricus* Georgi) is in close relationship with the „beluga" (*Huso huso* L.) of the Black and Kaspian Seas and is completely absent in the streams of Siberia. The carps (*Cyprinus carpio* L.) which are rather numerous not only in the Amur and its tributaries, but also in China, Korea and Japan (also on Formosa and Java) cannot be met with in Siberia; they occur, however, in the Black and the Kaspian Seas and throughout Southern and Central Europe. *Rhodeus sericeus* Pall., which is found in the Amur and is closely related with the Chinese *Rhodeus sinensis* Günth., is not met with in Siberian rivers, but appears again beyond the Ural in the rivers flowing into the Kaspian, Black and Baltic Seas; it likewise occurrs in Central Europe. We know now of about 10 cases of a

similar interrupted distribution in the ichtyofauna of the Amur, and they fully correspond to the similar cases of distribution of some molluscs, birds, mammals, amphibians and plants. An explanation of all these cases can be found in the supposition, that all these elements of the fauna and flora must be considered as remnants, preserved on the west and on the east, of the end of the Tertiary epoch, when they had their uninterrupted distribution and also inhabited Siberia. In the ice-age they were exterminated in Siberia, owing to the too severe climatical conditions, but were preserved on the coasts of the Pacific and beyond the Ural mountains, where the climate was more favourable. There is no doubt that the further exploration of the zoogeography of the countries bordering on the Pacific will greatly increase the number of cases of a similar zoogeographical distribution.

In the exploration of birds and mammals since the above-mentioned studies of Middendorff, Schrenck, Radde and Maack, we have none of any considerable value, but a certain quantity of notes and lists of numerous collections may be noted. As principal collectors of vertebrates of the Amur district must be mentioned Cherski, Yankovski, Dybovski and Godlevski. Our celebrated traveller in Central Asia, the late N. Przewalski also began his career here: in his first travels in the Ussuri district (1867—69) he made an excellent collection of birds.

More numerous are the collections and separate studies of the exceedingly rich fauna of insects of the Amur and the Ussuri districts. Large collections of Schrenck's expedition, that were studied by Ménétrier (butterflies) and Mochulski (beetles), established a stable basis for the further study of the insects of these countries.

Many Russian travellers during the last 50 years have collected most extensive materials for the study of the insects of our Far East region, and this material was augmented by the indefatigable work of a multitude of local collectors and naturalists. To show how large are these materials, available for study, we will only mention here the names of the chief collectors. Especially valuable were the collections, containing every group of insects, made in the Amur and the Ussuri districts by K. Maximowicz, D. Wulfius, H. Christoph, A. Cherski, F. Derbek, M. Yankovski, A. Rimski-Korsakov, Shingarev, Christinich, Miss Basnin



F. SCHMIDT
(born January 15, 1832, died November 8, 1908)

and others. Beetles were chiefly collected in the same districts by D. Ivanov, N. Palchevski, L. Grinevetski, G. Suvorov, M. Berger, M. Dukin. Butterflies were collected by A. Moltrecht and by Kurentsov, *Orthoptera* — by N. Ikonnikov. On Sakhalin the chief collectors were Lopatin, A. Nikolski, Dr Suprunenko, Seroshevski, P. Schmidt, and others. In Kamchatka entomological collections were made only by the Kamchatka expedition of Riabushinski, — and the chief collectors were V. Komarov, V. Bianchi, A. Derzhavin, and P. Schmidt. Comparatively few entomological collections were obtained from the Chukchan Peninsula, only Dr N. Sliunin, L. Grinevetski and N. Sokolnikov having collected there.

These entomological collections are preserved principally at the Zoological Museum of the Academy of Sciences of the USSR and have been systematized by the entomologists of the Museum. The results of their studies have been mostly published in the „Horae Societatis Entomologicae Rossicae", in the „Annuaire du Musée Zoologique" and in other publications of the Academy of Sciences. On the beetles of the Far East we may mention the revisions and lists of S. Solski, Blessig, A. and I. Kushakevich, A. Morawitz, G. Jacobson, A. Semenov-Tian-Shanski, J. Baeckmann, G. Suvorov, M. Berger, P. Spesivtsev, V. Barovski, M. Dukin, T. Chicherin, F. Dobrzhansky and others. On the butterflies the chief studies belong to G. Grum-Grzhimailo, O. Bremer, G. Christoph, S. Alferaki, O. Herz, A. Diakonov. The *Hymenoptera* were studied by Morawitz, O. Radoshkovski, A. Birula and A. Skorikov, the *Orthopthera* — by N. Adelung, E. Polynov, N. Ikonnikov and B. Uvarov, the *Diptera* — by J. Porchinski, Th. Pleske and A. Stakelberg, the *Hemiptera* — by V. Yakovlev, A. Kirichenko and A. Mordvilko, the *Trichoptera* — by A. Martynov. Lists of coleopterological collections from Sakhalin have been published by G. Jacobson, A. Semenov-Tian-Shanski, A. Morawitz, T. Chicherin and V. Kizeritski. The insects of Kamchatka were studied by Eschscholtz, B. Mochulski, G. Fischer-von-Waldheim and E. Ménétrier and in the last years have appeared the studies on *Hemiptera* of A. Kirichenko and on *Tri-*

choptera of A. Martynov. The insects of the coasts of the Okhotsk Sea and of the Chukchan Peninsula were studied by B. Mochulski, E. Ménétrier and A. Semenov-Tian-Shanski.

Russian entomologists have also done very much for the study of the insects of the neighbouring countries of North China, Korea, Japan, visited by many Russian travellers and collectors.

One of the most interesting entomological discoveries in the Ussuri district was a new beetle of the family *Cerambycidae*, described by A. Semenov-Tian-Shanski as *Callipogon relictus* — it belongs to a very old group, has nearest relations with forms, living in Central and South America, and must be regarded as a remnant of the Tertiary epoch.

But in spite of many entomological investigations it must be acknowledged that the insect fauna of the Pacific coasts is far from having been thoroughly investigated, and there is no doubt, that for a long time it will render most rich and interesting material to entomologists.

This brief historical sketch shows, that Russian scientists have expended a great deal of energy in the exploration of the fauna of the Pacific and of the neighbouring countries. At first their investigations were promoted by scientific interest alone, but later on, with the increase of the population of the country and with the development of fisheries and of the fur industry on the Amur, in Kamchatka and on the Commander Islands, scientific explorations have obtained a more practical character and have been directed chiefly to the study of fishes, fur-seals and other useful animals.

The importance of such scientific investigations of a practical character begins to be more and more acknowledged during the last decades, with the development of fisheries, and latterly also under the influence of the grave diminution in the number of fish due to over-fishing. The most scrupulously exact scientific study of the biology of fishes and of the physical conditions of their environment, of their food-supply and their migrations can alone afford a proper basis for their rational exploitation.

These new problems, that are set by the present conditions of life, create new demands upon scientific investigation. If it was formerly sufficient to bring a skin, a skeleton or an alcohol preparation of an animal for the enrichment of science with possibly some valuable discovery, a precise idea of the life of useful animals is now necessary to be given, which can only be obtained at the expense of years of the most persevering study, connected as it is with numerous measurements, weighings, dissections, microscopic investigations and, frequently, very complicated and expensive experiments, such, for instance, as the fish markings required for the study of fish migrations.

This alteration of the problems of scientific exploration had its influence on the methods of investigation. Instead of a simple collecting of zoological objects, that demands the exertions of a few, it has now become necessary to institute complicated collective researches of many scientists of different specialities and to have ships specially equipped for scientific work.

Moreover, if in the past expeditions of various countries could work in different parts of the sea and obtain scientific results of definite value, now, in view of the widening scope of contemporary scientific problems, presenting ever increasing difficulties, the study of the sea should be undertaken by the united efforts of all interested countries and so coordinated, as to conform to some one general plan, established with their concurrence. The same methods of investigation being followed by all, its results would very much gain in being made comparable.

In this respect we have a most convincing example in the organisation of an international scientific exploration of the north-eastern part of the Atlantic: „The International Council for the Study of the Sea" created by Great Britain, Germany, the Netherlands, Belgium, Denmark, Sweden, Norway, Russia and Finland in 1902. It drew up a general plan of marine investigations for all these countries, submitted scientific explorations to certain regulations, worked out new methods, raised new problems and coordinated the publication of reports.

The International Council organised also at Copenhagen a Central Laboratory for elaborating and testing oceanographic apparatus and instruments used for marine investigations.

Many scientific expeditions have been organised by the Governments represented in the Council, and they gave quite exceptional results for the benefit of science and practical purposes. It is only on the basis of these investigations that we are now enabled to draw nearer to the solution of the most complicated hydrological and biological problems of the North Atlantic and to give a proper and rational basis for meeting many practical needs. The complete elucidation of the biology of the plaice (*Pleuronectes platessa* L.) and the establishment of measures dealing with over-fishing in the North Sea, the solution of the problems connected with the migration of the herring and the cod and, at last, the unravelling of that most complicated zoological enigma — the life history, reproduction and development of the eel — all that would only be possible to achieve by means of international scientific cooperation.

In the North Pacific many most important biological, hydrological and practical problems connected with the sea industry are awaiting their solution. The study of the biology of salmons represented by the same species on both coasts of the Pacific, the question relating to the distribution and migration of the cod and the herring and the solution of various questions, connected with the fur-seal industry, all this requires a combination of scientific forces of all interested nations on both sides of the Pacific. And, before all, the hydrology of the North Pacific must be thoroughly studied, as only the knowledge of the physical conditions of the environment can help to trace the life cycles of fishes and of other useful animals. But the study of the hydrological conditions of such a vast extent of the Ocean can also succeed only by means of international cooperation.

As the nature and fauna of the North Pacific Ocean are not yet sufficiently investigated, it would be especially desirable to conduct preliminary exploration on a general plan and by means of equal methods, for the convenience of comparison and for drawing general deductions. It would also be of great advantage to coordinate the methods of exploration with those of the „International Council for the Study of the Sea", as then the tracing of parallels between the natural conditions of the Pacific and Atlantic Oceans would be rendered so much easier.

Hitherto, the exploration of the Pacific, undertaken by various countries, has not been coordinated, and it is a matter of difficulty to

compare the results obtained. However, the mighty unifying spirit of science exemplified in the organisation of Pan-Pacific Science Congresses gives us hopes, that an international agreement will be attained, and the exploration of the Pacific will be undertaken in future by the united forces of all interested nations and will give us a new example of the productiveness of scientific cooperation.

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Ethnography

by Leo Sternberg

I

Russia like Western Europe has had her age of great discoveries. Only the arena was different. The territory of Russian discoveries covers the whole of Northern Asia from the Ural mountains to the Pacific shore. Like America before Columbus, all this vast portion of the Asiatic continent was an absolute *terra incognita* to the European world, until the Russians set their foot on it in the XVIth century. As in the West, the first men to discover new lands and nations were adventurers, prompted by lust of conquest and avarice. As in the West, their path was marked everywhere by utter cruelty towards the natives, who were made the object of oppression and exploitation. Scientific research was resorted to not before the XVIIIth century and then only sporadically.

Thus we received our earliest information on the ethnography of Northern Asia from that band of intrepid men, who by their unrivalled courage and endurance, in the course of a hundred and fifty years have enlarged Russia with an entire continent stretching from the Ural mountains to Kamchatka. These men were known under the name of „cossacks". They were soon followed by another wave of adventurers, who were attracted to the newly discovered country by rumours of its enormous wealth in furs. These latter are the men who were known under the name of „promyshlenniki" (trappers, fur traders). Both these groups of pioneers were animated by two kinds of motives. Besides the passion for gain and conquest another

unselfish aspiration was born, that of discovering new lands and new nations.

All these adventurers, who soon became servants of the Crown, began to submit regular reports of their discoveries to the local authorities. These reports, which were written in artless language and laconical style, still give to the student most valuable information on the original distribution, number and character of the peoples, that inhabit Siberia and the Pacific shore. This information is particularly important, as the ethnographical peculiarities of these tribes have since undergone enormous changes and would be lost to science but for those reports. To show how important these reports are, it should be remembered, that the reports of the cossack Dezhnev, who discovered Bering Straits, a century before Bering, already contain a description of the American Eskimo. Unfortunately, these valuable documents have for a long time lain buried in local archives, and it needed a special scientific expedition to unearth them. At present, they have nearly all been edited in the publications of the Archaeographical Commission of the Academy of Sciences. The reports of men like Poyarkov, Khabarov, Atlasov, Stadukhin, Chernov and a number of less known adventurers remain until now the main original source for the ethnography of the tribes of the Pacific coast: Yukaghirs, Kamchadals, Chukchee, Koryaks and the tribes of the Amurland. It was only with their help that long afterwards L. Schrenck could find his way in the intricate labyrinth of the tribes of the Amurland.

One of these reports, which reached the central Government at a favourable moment, served as a starting point for the organisation of scientific expeditions to the Pacific and of ethnographical expeditions in particular. This was the report on the discovery of Kamchatka. It induced Peter the Great to send out the first of the famous Bering expeditions. The object of this expedition was to settle the question of the land connection between North America and Asia.

Russian ethnography in general and the ethnography of the peoples of the Pacific in particular is very much indebted to Bering's second, or so called „Kamchatka Expedition" (1733—1743). It was the first occasion in European history for an Academy of Sciences to take part in drawing up the plans of such an expedition, and ethnographical investigation was first included as an independent

scientific problem.[1] G. Müller, the famous Academician and professor of history and geography, drew up an instruction for the ethnographical work of the expedition. This instruction stands absolutely alone among the documents of its time for thoroughness and comprehensiveness, covering as it does all problems of ethnography, including linguistics. The Academy was not content to give general directives to the expedition. It attached to the staff of this expedition a number of its members, men, whose talents and education fitted them extremely well for their task. The head of the expedition was G. Müller, the author of the above-mentioned instruction. He was accompanied by a staff of scientists, amongst whom were investigators like Krasheninnikov and Steller.

This expedition lasted not less than ten years. Thus, in the history of ethnographic research this was the first stationary expedition, which type of expedition is now considered to be the only rational one. It was this stationary or resident character, as well as its carefully worked out plan, which made the results of this expedition an era in science. Although G. Müller, the leader of the expedition, could not himself visit Kamchatka and had to remain in Yakutsk, he did his expedition the invaluable service of discovering in the Siberian archives the old reports of the „cossacks" and the „promyshlenniki". These documents gave a clue to the history and geographical distribution of the tribes of the Pacific coasts for the period of 150 years. Among them was also Dezhnev's famous report of 1648. Müller made extensive use of these documents in his „Sammlung russischer Geschichte", and so did Fischer in his „History of Siberia".

By far the most valuable results of this expedition were the works of Steller and Krasheninnikov. The second volume of the latter's „Description of the land of Kamchatka", which contains 500 pages, together with Steller's publication under the same title, must be classed as a standard ethnographical monograph not only of Kamchatka, but of the entire cycle of the Pacific tribes of the Far North, — Kamchadals, Koryaks, Kuril islanders,

[1] The official order states the object of the Expedition to be as follows: „You are to investigate the American shore, land there and find out without fail by what sort of people it is inhabited... and if you find men, you must treat them kindly, harm nobody and show no aggressiveness nor unfriendliness...".

Chukchee and the neighbouring tribes of America. This work contains not only a description of the various aspects of Kamchadal culture; it raises also with far reaching insight many of those problems, the solution of which is being approached only in our time. Together with his colleague Steller, Krasheninnikov asks the question: „Where have the inhabitants of America come from?". A series of geographical and ethnographical comparisons led him to the conclusion, that they had immigrated from Asia. Krasheninnikov 180 years ago established the affinity of the Kamchadal language with that of the Koryaks and of the latter with that of the Chukchee. He says: „The Chukchee language is derived from that of the Koryaks, the difference being merely one of dialect". This problem has been finally solved only in the beginning of the present century by the Russian members of the Jesup Expedition. It is surprising indeed, that these early explorers laid so great a stress on linguistic material. They compiled short vocabularies of the language of each tribe and, besides, collected material for the study of dialects. Steller clearly distinguishes three dialects in the Kamchadal language, and Krasheninnikov does the same in Koryak. Besides a collection of words Steller published a valuable text — a translation of the Lord's prayer into Kamchadal. High credit also must be allowed to their ethnographical descriptions being singularly free from those phantastic elements which entered into almost all descriptions of their western contemporaries and even of such a distinguished ethnographer as Father Lafito. Krasheninnikov's work was duly appreciated by his contemporaries. Shortly after its publication it was translated into several foreign languages and was then considered the only authority on the ethnography of North-Eastern Asia and of the extreme north-west of America. The publications of Krasheninnikov—Steller have retained their scientific value until the present time. As regards the ethnography of the Kamchadals, which forms the bulk of their work, these investigators were the first and the last to deal with it; for already then the Kamchadals had almost died out, and the insignificant remainder were already becoming Russified. At the present time they have practically become Russians, and only a few of them have preserved their original language.

In addition to the material, which Krasheninnikov and

Steller had collected by stationary investigation, much ethnographic information was gathered by the hydro-geographical detachments of the Bering expedition.

While on board Bering's ship Steller was the first European to study the culture of the American insular Eskimo. The detachment of Spanberg which went as far as Japan, was the first to collect information on the Ainu of Yezo and the Kuril Islands. Of the people living on these islands the Russians knew since 1711 from runaway cossacks, who had gone there from Kamchatka. It remained, however, for Spanberg's expedition to establish the identity of the Ainu on Yezo and on the Kurils. This expedition is also memorable for the friendly reception which the Japanese accorded to them, as they did also to the expedition of Lachsmann and others. It can only be regretted, that the senseless raid of Khvostov and Davydov for a long time spoiled the relations between these two nations.

The discoveries of the second Kamchatka expedition had two results. Among the traders they created a desire to establish factories in the newly discovered countries, while the Government hastened to incorporate the new territories with the Empire and to make their inhabitants Russian subjects. Between 1745—62 local fur traders discovered the Aleutian Islands and collected the first information on their inhabitants. In 1763 a fur trader Glotov discovered Kadyak Island, and from that moment dates our closer aquaintance with the Eskimo. Thanks to the map drawn by Spanberg the sotnik (captain) Chernov was dispatched to the Kuril Islands in order to collect tribute (yasak) from the inhabitants (1766—67). It was then that the first detailed information about these people was received, and since then we have been in uninterrupted intercourse with the Ainu as far as Yezo. At the same time the territory of our fur trading enterprises spread over the islands and the mainland of America, and the Russians came into contact not only with the Eskimo tribes, but also with the north-western Indians—the Tlingits and the Athapaskans. This extension of territory for the sake of our fur trade had two important consequences. First of all it induced the trading enterprises to unite into companies. The final result of this tendency was the organisation of the Russian-American Company, which occurred in the beginning of the XIXth century.

In order to establish its business on a rational basis and to improve the supply of merchandise for the factories, this Company started expeditions which, while carrying on hydrographic and other work, collected also ethnographical information. On the other hand, the Government became aware that to meet the needs of its new possessions it must organise purely scientific marine expeditions to the newly discovered countries.

These marine expeditions, opened by the voyage of Billings and Sarychev (1785—1793) were merely a link in the chain of the famous expeditions which the Academy of Sciences had organised with a view to a comprehensive investigation of European and Asiatic Russia. These expeditions played an important part in the history of ethnography. The instructions of the Academy, besides setting before these expeditions various scientific and other aims, directed them to „collect everything that sheds light on manners, various customs, languages, traditions and antiquities". It is true that the marine expeditions had in the main hydrogeographical and naturalist tasks, but they at the same time carried out a considerable amount of ethnographical research. Thus, e. g., Pallas for the expedition of Billings drew up a special linguistic instruction.

The expedition of Billings and Sarychev was followed by several other expeditions of which, not to speak of less important expeditions, special mention deserve the voyages round the world of Krusenstern and Lisianski, Kotzebue, Lütke, Golovnin, Bellingshausen, in which a number of eminent men of science took part.

All these expeditions to the peoples inhabiting the northern parts of the Pacific brought back much new ethnographic matter. The expedition of Billings and Sarychev was the first to give an idea of the life of the Chukchee, as well as to collect detailed information on the Yukaghirs, the Tungus of the Okhotsk region and of American tribes (Chugaches, Kenais and Aleuts). During this expedition Dr Robeck, following the instructions of Pallas, compiled a vocabulary of twelve native idioms, Billings established the identity of the Asiatic Eskimo, whom he and his contemporaries took for settled Chukchee, with the American Eskimo. Lisianski gave a description of the Eskimo on Kadyak Island, among whom he spent a year, of the Kenais and also of the Aleuts on Unalashka

Island. He also collected lexicographical material. Langsdorff described the Kadyaks and Tlingits, visited the Ainu on Yezo Island and the Californians, and has left a very valuable sketch on dog-breeding amongst the Kamchadals. Moreover, he was the first to give us comparative lexicographical material on the various Ainu dialects. The detailed description, which Khvostov and Davydov gave of the various sides of Konyag life, deserves special notice. These two men also collected considerable lexicographical material on the language of the Koonyags and Koloshes (Tlingits). Another skilled observer was Lütke. To him we owe a detailed description of the Tlingits, for which he used, besides his personal observations, the notes of Khlebnikov, an old resident among this tribe. Starting from the affinities of the Aleut language with that of the Eskimo and from the affinity of the languages of the so-called Namolls and Kadyaks with that of the Eskimo as a whole, he tried to solve the question which is at present agitating the Americanists, whether the inhabitants of the polar zone came from Asia into America or vice versa. It is well known that at about the same time the famous linguist Klaproth, who was then curator of the Asiatic Museum at St. Petersburg, came to a solution of this question with the help of the materials collected by our explorers. His theory was that the polar people had come from America and he consequently called the Chukchee-Koryak group — „Polar-Amerikaner". While on the staff of the Kotzebue expedition, Dr Eschberg made a serious study of the Aleut language and established its affinity with that of the Eskimo. It also may be mentioned here that the entire lexicographical material collected by these expeditions was utilised by Adelung and Vater in their well known work „Mithridates".

It was not the least among the merits of the members of these expeditions that they brought home valuable ethnographical collections and excellent drawings. The majority of the publications of these expeditions, as well as those of the Kamchatka expedition, appeared both in Russian and in several European languages, and became thus available for science in general.

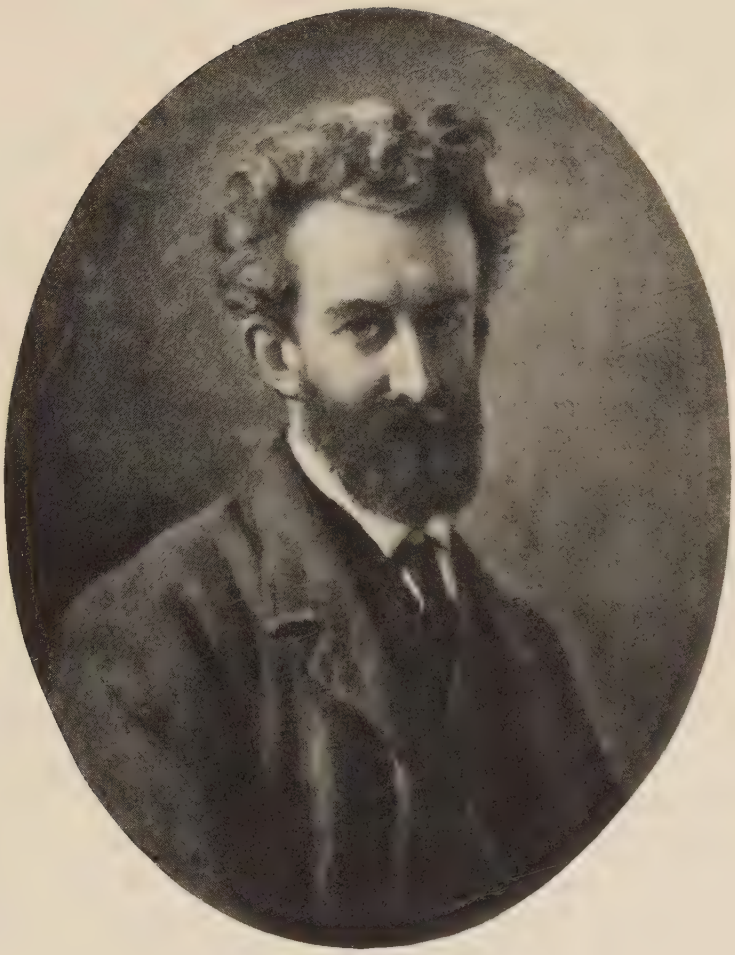
The overland journey of Wrangel from Kolyma to the Bering Strait stands on a separate plane. Wrangel was a keen observer and a brilliant writer and has left an excellent description of polar life, which has still lost nothing of its freshness and vividness.

He was the first to traverse the whole territory of the Chukchee, Yukaghirs and northern Tungus and made subtle observations on the psychological peculiarities of each of these peoples. His well balanced psychological analysis leads to the conclusion, that reindeer breeding among the Chukchee is of a relatively recent date.

Two men must be mentioned here, who took no part in any of the expeditions, but to whom ethnography of the North Pacific owes much. They were lieutenant Zagoskin and the zoologist Voznesenski. Both visited these territories in the forties of the last century at about the same time. Zagoskin, who was chiefly occupied with topographical work, collected valuable material on the statistics and ethnography of the Norton Sound Eskimo, of the tribes living along the Yukon and Kuskokvim rivers, as well as of the Athapaskans. He also brought home a valuable collection of ethnographical objects. He differed from former travellers, who merely investigated the sea coast, in that he penetrated into the interior of the country. He could thus give us a true notion, possessing much historical value, of the geographical distribution of the tribes he had visited. His observations are distinguished by great accuracy and love of detail. His description of the remarkable „potlatch" institution, which he was the first to give, deserves special mention. He indicates one exceedingly important detail which sheds light on the meaning of this custom and which has not yet found its proper place in science, viz. the exceptional importance attached to the namesake of the deceased, in whose honour the „potlatch" is celebrated.

Voznesenski was a true hero of science. In spite of the scanty means at his disposal and notwithstanding his being charged by the Academy with numerous commissions in practically all branches of natural science, he found time to collect ethnographical material among a vast number of tribes — Chukchee, Koryaks, Asiatic and American Eskimo, Aleuts, Athapaskans, Tlingits and even Canadian and Californian Indians. The collections, which he brought home, exhibited in the Museum of Anthropology and Ethnography of the Academy of Sciences, are now almost unique and of the greatest scientific value.

Even on the background of such a brilliant galaxy of investigators the figure of the missionary I. Veniaminov — afterwards Innocent, Metropolitan of Moscow — stands prominently forth both in view of his personality and his scientific merits. His methods of work-



N. MIKLUKHO-MAKLAI
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ing were quite different from those of his predecessors and contemporaries, who came into contact with the natives but for a short time and talked with them through interpreters, so that the linguistic result of their visits usually amounted but to short lists of words. Veniaminov, on the other hand, residing for many years among the people whom he describes, and speaking their language perfectly, adopted the „stationary" method of investigation.

He spent altogether 16 years among the natives of the North Pacific, ten among the Aleuts and six among the Tlingits. His missionaries' duties gave him ample opportunity to become aquainted with all sides of their material and spiritual culture. Besides being a gifted and shrewd observer, he was also a man of great education and, what is especially important for an ethnographer, he knew how to gain the confidence and sympathy of the natives. His extensive description of the insular Aleuts, who were then already beginning to lose their old culture, combines thoroughness with searching psychological analysis. These peoples having since entirely lost their national character, at least as far as material culture goes, the work of Veniaminov is our only and last source, from which we can study the extinct culture of these peoples. His works were translated into foreign languages immediately after their appearance. His grammar of the language of the Aleut islanders is still the first and only work of its kind. Of the importance of Veniaminov's works on the Aleuts even for our time we may judge best from what Henry Elliot says in his book on Alaska:[1] „Veniaminov's work is unique,... and without it we would be wandering in the dark as the Russians did during all the time they were the masters of this country". As regards Veniaminov's work on the Tlingits, Krause, who knows this tribe better than anyone else in our days, says:[2] „He has done more than anybody else for the understanding of the character, the manners and customs of the natives... To him we are indebted for a most complete collection of the mythological tales of the Tlingits. His contributions to the study of their language are equally valuable. He was a good and veracious observer. Wherever we had the possibility of checking his facts, we found them always perfectly accurate".

The series of investigations which the Russians carried out in

[1] H. Elliot. An arctic Province: Alaska and the Seal Islands. L. 1880, p. 309.
[2] Krause. Die Tlinkit Indianer. L. 1891, p. 65.

the extreme north of the Pacific during the first decades of the XIXth century, closes with the well known journey, which Middendorff undertook in the forties in the southern part of the Sea of Okhotsk. He there reached the extreme northern border of the Gilyaks in the Tugur Bay. Turning to the left tributaries of the Amur river, he came into contact with several Tungus tribes, on whom he was the first to bring interesting information. Among these tribes were the Manegghirs and especially the Neghidals, of whose clan organisation and language he gave a detailed account. Thus for the first time a Russian scientist met those same peoples, who had been discovered by the Russian cossacks in the XVIIth century.

Finally, in the fifties the explorations of Dittmar took place, who described the life of the Koryaks and the Chukchee and drew up the first ethnographical map of Kamchatka.

II

The further study of the population of the Amurland, which had been commenced by Middendorff, is connected with the penetration of the Russians on to the lower reaches of the Amur river. This event took place after Nevelskoi had discovered the straits between the Island of Sakhalin and the mainland of Asia.

The first to give provisional but very accurate accounts of the population living on the lower reaches of the Amur river and on Sakhalin, were employees of the Russian-American Company. In the main, however, this information is due to those energetic men, who took part in Nevelskoi's Amur expedition.

It was at that time (in the middle of the fifties) that the Academy of Sciences came once more to the fore, as it had done a century ago after the discovery of Kamchatka. A composite expedition was organised to study the Amurland from all points of view. Its ethnographical part was placed into the hands of Schrenck, who spent two and a half years in the Amurland. His monograph on the tribes of the Amurland consists of three volumes containing history and ethnography and two supplements dealing with language. This work has become classic and is known to every scientist. Schrenck can in truth be called the Columbus of the ethnography of the Amurland. After extensive historical research and personal observations he established for the first time a scientific

classification of the numerous Amur tribes, created for these tribes the first ethnical terminology, which is still generally accepted, and gave a historical and ethnographical description of each tribe. A number of tribes, the very names of which had formerly been almost unknown, took shape and stood in flesh and blood before the eyes of the scientists.

The greatest part of his work deals with the ethnography of the Gilyaks. Taking into account the absence of any previous workers in this field, his description must be considered a model of completeness and searching analysis. The task, which fell to his lot, was enormous. There was nobody in that region, who had even a slight knowledge of the local languages. Although he could not master them sufficiently he succeeded in collecting such an amount of material on the lexicon and partly on the grammar that in the hands of the well known oriental scholar Grube it gave us the first clear idea of this peculiar language. His notes on the language of the Golds, together with the notes of Maximowicz, another member of the expedition, formed the basis of Grube's dictionary of the Gold language. Schrenck did also pioneer work for the craniology of the Amurland.

Schrenck's works are stamped with the breadth of view, with which he approaches the peoples and cultures he describes. He was not content with mere description, but ever tried to find out the interrelations between the peoples and their cultures. Each people, each culture was for him a new problem of history and comparative ethnology. His treatment of these problems enabled him to establish a number of very important facts, e. g. that dog driving in the Amurland is of Gilyak origin; that the settled Tungus tribes have formerly been reindeer nomads, who had lost their cattle. He also advanced a new theory on the connection of the Ainu with the Koreans.

His name is also for ever connected with one of the principal questions of Pacific ethnography. It was he who set apart a group of peoples radically differing from the Uralo-Altaian group in their linguistic traits. This group he called Paleoasiatics, a name that has become generally accepted. It is true that his classification, based as it is on merely negative characteristics, has since been modified in some respects, and that he was not in a position to solve the

problem of the origin of this group; but subsequent investigations have shown that merely raising this problem, of which nobody had thought before him, was in itself an important acquisition in science.

After Schrenck in the sixties the scientific study of the population of the Amurland was taken up in an energetic and systematical manner and has been carried on in that way to this day.

Educated people began to settlle in the new territory and developed an interest in its history and population. Periodical publications have appeared, in which ethnographical questions were discussed. Learned societies were founded, such, as the „Society for the Study of the Amurland" at Vladivostok, Branches of the Geographical Society at Khabarovsk and Chita, as also Museums at Vladivostok, Khabarovsk, Chita and Alexandrovsk. On the Island of Sakhalin and in the far north-east considerable work has been done by those educated men, who had been transported there for political offences and enthusiastically devoted themselves to ethnographical work.

In the following short review of the work hitherto done we shall do best by following Schrenck's classification and setting apart the works on the Paleoasiatic group, which plays such a prominent part in the problem of the Pacific.

We begin with a survey of the Tungus tribes. The Golds are the most numerous Tungus tribe of the Russian Amurland, and it is but natural that most attention has been given to them. The first to describe all the Gold tribes living along the Amur and Ussuri rivers was Maack (1855), who was entrusted with this work by the Irkutsk Branch of the Geographical Society. His two voluminous publications „A journey on the Amur" and „A journey in the Ussuri valley" together with an excellent album of drawings are still the chief source of our knowledge of the subject. A. Brylkin, who accompanied him on his Ussuri expedition, compiled a short dictionary of the Gold language and also gave the first sketch of a Gold grammar. Maack's example was followed by a number of descriptions, which appeared in the works of various travellers, like Veniukov, Przewalski, Nadarov and many others. From among recent, purely ethnographical, works mention must be made of Shimkevich's publications on the shamanism and folklore of the Golds, and of Lopatin's comprehensive work „The Golds", which contains also an historical survey of previous work in this field.

In 1910 the religion and social organisation of the Golds were studied by L. Sternberg, the results of his investigations having as yet only partly been published. On the language of the Amur Golds we have besides the materials of Schrenck, Maximowicz and Maack, the publications of the brothers A. and P. Protodiakonov — a Gold dictionary, songs, ballads, a translation of the Gospel, etc. It was mainly on the basis of this material that the manchurist Zakharov came to the conclusion that the Gold language is closely related to Manchu. Material on the language of the Sungari Golds was collected by Dobrolovski in 1903 and published by Kotvich in the „ Zhivaya Starina", in 1909.

The Orochee are another important Tungus tribe. They were first described, in so far as they live within the confines of Imperial, now Soviet Harbour, by Margaritov. The latter gave an anthropological description of them, based on craniological measurements and published also a short list of Orochee words. In 1896 S. Leontovich published a short dictionary of the Tumnin dialect of the Orochee language with considerable grammatical notes, and wrote an extensive paper on their way of living. In the same year the Orochee were studied by L. Sternberg, who paid particular attention to their social organisation and cult. He was the first to establish that they originally called themselves „nani", a name, which he also discovered among other settled Tungus tribes — Golds, Olchee and Oroks; he found out their northern origin and discovered amongst them survivals of the classificatory system of relationship. The southern Orochee (the so called Udykhe) were for the first time described more or less in detail by S. Brailovski who not only gave ethnographical, but anthropological and lexicographical material. This tribe has been most extensively studied by the well known traveller and explorer of the Amurland, V. Arseniev, who has worked amongst them off and on for about 25 years. The results of his investigations will be published in the near future. He tells many interesting facts concerning this tribe in his book „In the Ussuriland", which has been translated into foreign languages.

The social culture and religion of the Neghidals were studied by L. Sternberg, who also collected material on their language (as yet unpublished). A short dictionary was published by P. Schmidt,

as also one of the Olchee language. The ethnography of the latter tribe was studied by B. Pilsudski, who also collected (unpublished) lexicographical material. An extensive investigation of the ethnography of the Orochee in Transbaikalia was undertaken by S. Shirokogorov, who has so far published a paper on their shamanism. He also published in 1924 a detailed and quite original paper in English on the social organisation of the Manchu. In the nineties Ivanovski wrote on the Solons and Daurs. At present an expedition of the Academy of Sciences is studying the Samoghirs and Neghidals in the Amur basin.

In the study of the Tungus tribes the ethnographer in questions of ethnical affinities and origin has to rely on the historical evidence of their neighbours, chiefly of China and Manchuria. In this respect ethnography owes a great debt to the works of our sinologists: Vasiliev, Hyacinth, Gorski and especially Palladius. The latter for the history of the Ussuriland especially used Chinese sources to which he was the only man to have had access. These works have placed beyond all doubt the fact that in the VIIth century there still existed in the Ussuriland the civilized Manchu State Bokhai, which was under Chinese influence. By his translation of the Chinese inscription on the monument of Tyr the Sinologist Popov has thrown light on the distribution of the population of the lower Amurland in the XVth century.

Archaeology serves as an auxiliary science to modern and historical ethnography. Many men have worked in this field: Busse and Nadarov in the South Ussuriland, Margaritov on the shores of the Amur Bay, min. eng. Lopatin on Sakhalin, Poliakov on south and north Sakhalin, Dr Suprunenko on south Sakhalin, Sternberg on north Sakhalin, Amgun and the lower Amur reaches, Pilsudski on Sakhalin. Their work has shown that the remnants of historical archaeology in the region of the southern Ussuri as well as on the Amur are of Chinese - Manchurian origin. As regards the neolithic period, the only theory, which has so far been advanced, was formulated by Busse and Nadarov with references to Hyacinth. According to this theory the neolithic civilisation on Sakhalin and in the Amurland is the same, and its representatives were the Tungus tribes of the Sushen group. This hypothesis, perhaps true of the Amur land, can hardly be applied in its entirety

to the prehistoric remains found in Sakhalin, many of which differ much in type from those in the Amurland.

One word more is to be said of the northern reindeer breeding Tungus, who inhabit the Okhotsk district and Kamchatka. After the descriptions, left us by the early travellers of the end of the XVIIIth and the beginning of the XIXth century, and the accounts, given of them by Middendorff, we have no special investigations on the subject, excepting perhaps a paper by Pekarski and Tsvietkov which is rather of an economical and statistical nature. Considerably more has been done for the study of the language. Popov translated in 1854 the Gospel of Matthew into the dialect of the Okhotsk Tungus. Together with the materials of the early travellers and the notes of Spaski (1820) it served as a foundation for Schiefner's „Beiträge zur Kenntniss der Tungusischen Mundarten". The latter also systematized Maydel's notes on the Anadyr dialect. Extensive material on the Lamut language has been collected by V. Bogoras (1893—94)—a dictionary, short grammar and texts, which unfortunately are as yet not published.

The Paleoasiatic group, which comprises the most enigmatic of the peoples inhabiting the Pacific shore — the Yukaghirs, Chukchee, Koryaks, Asiatic Eskimo, Gilyaks and partly Ainu — has been particularly fortunate in its having been studied better than any other group and, with the exception of the Ainu of Japan, exclusively by Russian scholars. The bulk of the Ainu live on Japanese territory, and to Japanese scientists belongs the merit of having set the study of the Ainu especially their anthropology and archaeology, on a firm basis.

The Russians first met representatives of the Ainu on the Kuril Islands, Krasheninnikov described them and communicated specimens of their language. Short descriptions of them and vocabularies can be found in the works of nearly all the early Russian travellers; Voznesenski in the forties collected a small, but interesting set of ethnographical objects, which are exhibited in the Museum of Anthropology and Ethnography of the Academy of Sciences. Radlinski has left a dictionary of the Kuril language, and in 1871 Polonski wrote a monograph „The Kurils". The study of the Ainu of Sakhalin began soon after the first Russian settlements in that island. One of the members of Schmidt's expedition to the Amurland, Brylkin, took up the study of the Ainu language of

which he compiled a large dictionary. It is a matter of great regret that this valuable material has perished. Schmidt in his reports to the Geographical Society and in „Petermanns Mitteilungen" communicated his interesting observations on the life of the Ainu. At the same time as Schmidt the geologist Lopatin worked on Sakhalin. He has made valuable discoveries of the neolithic culture. Space does not permit me to enumerate all those Russian travellers, who have written on the Ainu, and I must content myself with mentioning a few of the more important publications. In 1875 the Ainu — Russian dictionary of Dobrotvorski was published. This work, the most important in the seventies, has a lasting scientific value. It was the first, and has so far been the only dictionary of the Sakhalin dialect and contains a wealth of lexicographical and phraseological material. The author's untimely death prevented him from systematizing the extensive ethnographical material which he had collected. At about the same time D. Anuchin published his monograph on the anthropology of this tribe, the anthropological affinities of which are still puzzling scientists. In his work, which was the first serious attempt on the subject, anthropological methods were used for the first time to refute the theory that the Ainu belong to the Caucasian race. In 1903—05 the Ainu found an enthusiastic student in the late B. Pilsudski. He had a perfect knowledge of their language, collected extensive material on their folklore and gained their sympathy to such an degree, that he became acquainted with the most intimate sides of their life. Besides papers on individual questions, which appeared in Russian and foreign periodicals, he published in 1914 in English the first issue of his folkloristic texts with translations and valuable linguistic notes. His other works are still awating publication. Together with another ethnographer, Sieroshevski, Pilsudski also studied the Ainu of Yezo Island. Amongst them, as well as in Sakhalin, he made valuable collections, which are exhibited in the Museum of Anthropology and Ethnography of the Academy of Sciences. He also collected folkloristic material among the Gilyaks. Somewhat earlier than Pilsudski, L. Sternberg took up the study of the Ainu, chiefly of their religion and social organisation, in connection with his investigations of the Ghilyaks, who are neighbours of the Ainu. He particularly studied their curious cult of „inau" and advanced a theory of its origin.

On the Gilyaks the first detailed monograph was written, as has already been said, by Schrenck. In view of his manifold interests in the field of natural science he could not master their language, and therefore the most intimate sides of their life — their social organisation, beliefs and folklore were either not dealt with at all, or wrongly interpreted, as e. g. their family organisation. These sides of Gilyak life were taken up together with a special study of their language by L. Sternberg who has lived in the Amurland in the nineties for about eight years and visited it for a second time in 1910. In the publications of the Academy of Sciences, he has edited for the first time a series of folkloristic texts with translations and ethnological notes as well as a sketch of the phonetics and grammar of the Gilyak language. Besides this, he has published the results of his studies of their social organisation and beliefs. The main value of Sternberg's work in the domain of Pacific ethnology lies thus in his linguistic researches, that have led him to the important conclusion of the Gilyak language belonging to the Americanoid group. No less important not only for the study of the Pacific but also for ethnology in general, was his discovery among the Gilyaks of a classificatory system of relationship, one-sided cousin marriage and survivals of group marriage. This discovery induced him to extend his investigations in social organisation not only to the Gilyaks of Sakhalin and of the mainland, but also to the Tungus tribes of the Golds, Orochee, Olchee, Neghidals and Oroks, amongst whom he found the same system but slightly modified. It became subsequently evident, that, to judge from survivals, this system existed once among the majority of the Uralo-Altaic peoples, and brings all these people into relationship, at least as far as regards family organisation, with the American Indians, on one hand, and the Dravidians of India, on the other. In view of its connection with the problem of the North Pacific his work on the Gilyaks and their neighbours including the Ainu will be published in the series of the Jesup expedition. The somatic anthropology of the Gilyaks has been dealt with by G. Maniser, who has systematized the extensive measurements which V. Vasiliev had made on Sakhalin and the Amur.

Prominent among the contributions towards the solution of the Pacific problem and of great importance for ethnography in general is the research work of the two eminent investigators — Jochelson

and Bogoras — among the Paleoasiatic tribes in the extreme north-east of Asia (Yukaghirs, Chukchee, Koryaks, Kamchadals and Asiatic Eskimo). As the first results of their work which they carried on during two years (1895—1897) while on the staff of the so called Sibiriakov expedition of the Irkutsk Branch of the Geographical Society, a series of folkloristic texts with linguistic notes of the Yukaghirs were published by Jochelson and of the Chukchee by Bogoras. These publications have shown their thorough familiarity with the life and the languages of these tribes, of which until then there existed only some fragmentary, wholly unscientific notes. Shortly afterwards these ethnographers were invited to take part in the famous Jesup Expedition, whose purpose it was to study the connections between the peoples of North-Western America and North-Eastern Asia. The investigations of the Chukchee and the Asiatic Eskimo were carried out by Bogoras, and those of the Koryaks by Jochelson. As a result two monumental monographs appeared on the ethnography of the Chukchee and Koryaks which must justly be considered standard works in every respect. Jochelson published also a similar monograph on the Yukaghirs while Bogoras has recently given an extensive grammar of the Chukchee-Koryak language for the „Handbook of American Languahes", edited by F. Boas. The only Paleoasiatic tribes which it remained to investigate into were the Kamchadals and the Aleuts. Of the former only a handful had been left who, although they were quite Russified, preserved here and there traces of their original language, which it was necessary to save for science. As regards the Aleuts, their affinities with the Eskimo had to be cleared up. In spite of his advanced age Jochelson took upon himself this task and spent about three years in the field as leader of the ethnological section of the Riabushinski expedition, which was organised in 1908 by the Russian Geographical Society. Although very few Aleuts have been left over, and all of them have become Americanised to a considerable extent, he was able to collect extensive material on their very peculiar folklore, from which we can form a vivid idea of their former social and religious life. Having studied their language scientifically, he was able to correct the mistakes made by his predecessor Veniaminov. Moreover, by a series of successful excavations he was able to reconstruct Aleut culture as it existed in a remote anti-

quity. He had a similar success in his study of the Kamchadals. At present his works on the folklore and archaeology of the Aleuts are being printed in English, while his investigations among the Kamchadals are being prepared for publication. The extensive anthropological material which Jochelson and Bogoras collected during the Jesup Expedition, and of which only a part has been systematized and issued by Mrs Jochelson-Brodski, is still awaiting publication, and so are the dictionaries of the languages of the tribes they have investigated. The writings of Jochelson and Bogoras are of great importance not only for ethnography in general, but especially for the problems of the North Pacific. They have proved once for all that the languages of the Chukchee-Koryak group, as well as the Yukaghir language are in various degrees related to the American languages, while the Aleut language is nothing but a dialect of the Eskimo languages. The linguistic evidence is borne out by the fact that the folklore of the northern Paleoasiatics contains much more elements which are similar to and even identical with American elements, than with the Uralo-Altaic ones. The linguistic and cultural affinities of the Paleoasiatics with the Americanoids must now be considered a proven fact. The discussion, which is still going on, only concerns the question, whether the distribution of the Paleoasiatics took place from Asia into America, or by a backward migration from America into Asia. The American scholars are inclined to admit the second alternative, which view is also accepted by Jochelson. Bogoras, however, being a patriot of Asia, is inclined to insist on a unity not only of the entire polar culture as far as the Lapps (which reminds one of Peschel's Hyperborean family theory), but also on the genetic unity of many Uralo-Altaic tribes with the Paleoasiatics. The time has certainly not yet come to raise such a far reaching question, but its solution will also involve the solution of the question as to the original route by which the Paleoasiatics were diffused, and of their ethnical origin.

For the time being we have to cope with several very important problems of less general character, which are still awaiting their solution. We have to find out, in which direction the distribution of the Eskimo took place, whether from America or from Asia. The degree of affinity between the languages of the Yukaghirs and Gilyaks and those of the Chukchee group also wants to be established.

The question as to the origin of reindeer breeding among the Chukchee is still awaiting its final solution. Finally, there remains the question of the relationship between Chukchee and Koryaks. For, in spite of their linguistic unity, these two tribes differ greatly from each other in such traits of their cultures, which ethnology considers as the fundamental and constant peculiarities of any group, as e. g. in their family organisation. Moreover, they show marked differences in their physical structure. Unfortunately, although this was evident as far back as at Krasheninnikov's time, no attention was paid to it till now.

All the same, the main problem has been solved. The researches of Bogoras, Jochelson and Sternberg have established, once for all that the languages of the Chukchee group, as well as those of the Yukaghirs, and Gilyaks, i. e. of all Paleoasiatics of North-Eastern Asia except the Ainu are akin to the American ones. This opens a vista on to a new vast problem, viz., to which of the American languages the Paleoasiatic languages are related.

An appreciation of this important work on the Paleoasiatics cannot be concluded without paying a debt of gratitude to the Academy of Sciences, which has from its very beginnig liberally supported the study of native languages. As regards the Paleoasiatic languages, special credit is due to the late Academicians V. Radlov and particularly K. Zalemann, whose never failing cooperation has made the linguistic material of the Paleoasiatics available for science.

III

It remains now to give a short survey of the contributions, which Russian investigators have made towards the study of the peoples of the South Pacific.

With the exception of Miklukho-Maklay, the Russian investigations in the ethnography of the South Pacific were connected with the famous voyages round the world, which took place in the first quarter of the last century, particularly with those of Krusenstern, Lisianski, Golovnin, Kotzebue and Lütke. The leaders of these expeditions were naval officers, very able men with a thirst for knowledge and discoveries. They had on their staff

talented scientists like Chamisso, Langsdorff, Mertens, Tilesius and others, who had also a keen interest in ethnography.

The work done by these expeditions is not only of historical interest. The early discoveries in the South Pacific had given rise to a lively and highly fruitful discussion on the great problem of the origin and expansion of the Polynesians, a problem which has not ceased to attract the greatest interest on the part of ethnologists and students of the history of human culture. Our expeditions enriching, as they did, the science of oceanography with new data on the sea currents and the direction of periodical winds, furnished abundant material, with the help of which the great roads of migration in the Pacific could be established. But besides this, the purely ethnographical data brought together by our investigators have shed light on this problem. It is but just to pay tribute to the breadth of view with which some of those explorers interpret their observations. Many of their theories have since become common places of our science. In this respect the name of the celebrated Chamisso, who was on the staff of the Kotzebue expedition, stands forth as a memorable example. He analyzed the observations which our sailors made on the sea currents and the direction of the predominant winds, and formed a correct conclusion as to the original starting point of the migrations in Polynesia. His ingenious argument that the South American aborigines were not acquainted with seafaring did once and for all away with the one time fashionable hypothesis, according to which the Polynesians had come from South America. He also skilfully put together the scanty but carefully collected materials, which were then available on the languages of Oceania, and established thus the unity of the Polynesian race. By a penetrating analysis of the ethnographical material he came to the conclusion that the migrations in the Pacific took place at a comparatively recent time. He also refuted on the basis of his own observations the belief which was widely accepted at his time, that the coarse megalithic figures of Easter Island were connected with the architecture of Peru.

Lütke too had a great interest for problems of a general character. Thus, e. g. in his description of Yualan Island he points out several peculiarities of its culture, which remind him of the Shinto cult of the Japanese. The descriptive material which those explorers

of a hundred years ago have left us, still retain their value. Much of what could be observed at that time has since entirely disappeared under European influence.

Krusenstern and Langsdorff had the good fortune to come into touch with two Europeans, who had for many years lived on Nukahiva Island and had a perfect knowledge of the local language and customs. The Russian explorers used this valuable material to draw up a picture of the material culture, social organisation and beliefs of the natives of that island. The detailed description of the local variety of taboo, given by Langsdorff, is of particular interest, and so are the musical records of Tilesius, and also the valuable sketches of anthropological types, objects of worship and tatooing drawn from nature. To Lisianski we are indebted for information about the natives of Easter Island, the first after La Perouse, and also for an extensive description of the culture of the Sandwich Islands. He and Krusenstern also made up an ethnographical collection, which on account of its uniqueness is the pride of the Museum of the Academy of Sciences.

Golovnin gave an ethnographical sketch of the Hawaii and Mariana Islands and was the first after Cook to study the natives on the islands of Tahiti and the New Hebrides. Lütke's description of the life of the Caroline islanders remains to this day one of the chief sources for the ethnography of that group. A detailed description deals with the island of Yualan, containing statistics, material culture, tatooing, beliefs, ritual, texts, etc. Lütke has also compiled a comparative dictionary of the dialects spoken on the Carolines and has made a drawing of a very interesting compass from the island of Luconore.

His fellow-traveller, Mertens, availed himself of the observations of an Englishman, who had for many years lived on the Caroline Islands, and drew up an excellent picture of native life. He also has left a classic sketch on the ethno-botany of that archipelago.

Chamisso too collected descriptive material of great value. He is justified in saying that he knew the secret of getting into intimate touch with the natives as none of the investigators before him. He was the first among the early travellers, who intercoursed with the natives of Polynesia in one of their own languages, namely the Radak language. This enabled him to give a valuable description of

Radak culture. Moreover, he collected materials for a comparative linguistic survey of some of the Mariana, Caroline and Marshall Islands and gave texts of Radak songs with translations. His general outline of the ethnography of Oceania, and of the Caroline, Mariana and Marshall Islands in particular, he has filled with a wealth of novel personal observations made on the different islands of the Pacific. In a separate essay he deals with the various methods of fire-making in use on the Pacific islands. It may be mentioned in passing, that he was the first to note that tatooing is in many cases not so much a kind of attire as a religious act. The Kotzebue expedition, to which Chamisso belonged, also collected interesting data on the ethnography of the Samoa Islands.

The Papuas and Melanesians lay outside the course which our sailors took on their voyages round the world. It was left to the seamen of Western Europe to study the peoples of this region. Nevertheless Russian science has made a valuable contribution even in this field. I am speaking of K. E. Baer's paper „Papuas und Alfuren". This work contains a critical analysis of all anthropological facts which were then available, and of the theories as to the types and distribution of the black race in the Southern Pacific. We also find there a number of suggestions and ideas, which were far in advance of their time, and formed the basis for further research work. It may be mentioned that he was the first to point out, how the problem of the black race in the Pacific could be furthered by studying the remnants of this race in India, an idea which was subsequently put to good use by Topinard in his study of the Dravidian question.

In the same connection he insisted on the necessity of studying the anthropology and ethnography of the East-African Negroes, an idea which has been used by Ratzel and his successors in the field of African research. It should also not be forgotten that he advocated most insistently the necessity of anthropological expeditions to New Guinea. It is well known that the young Russian scholar Miklukho-Maklay generously responded to this call ten years later.[1]

Finally, this eminent work will remain memorable in the history

[1] Miklukho-Maklay in his first publication used as an epigraph the following motto quoted from Baer's work: „So ist es doch wünschenswert und man kann sagen wissenschaftlich notwendig, dass die Bewohner von Neu-Guinea vollständig untersucht werden".

of science for its concluding chapter. There this famous biologist in the same year, in which Darwin's „Origin of Species" appeared, expounded in connection with the problem of the black race his profound views on the origin of the species and human races and on the problem of monogenesis and polygenesis.

Miklukho-Maklay is the latest of the Russian explorers in the South Pacific. His scientific career is a matter of general knowledge. Fifteen years of his life has this man spent in studying the natives of Melanesia. Twice he made the aborigines of New Guinea the object of prolonged investigations, living for years at a stretch among the savages, without seeing a European face. Nor was this all, for he wandered for several years, travelling from the Admiralty Islands and New Caledonia over the island of Yap, the Pelaw archipelago, the Moluccas, west Caroline and Celebes, as far as the island of Luzon and the Malay Peninsula. This long journey was exclusively devoted to anthropological and ethnographical research. On the Malay Peninsula he succeeded in penetrating far enough into the interior to study, first of European scientists, the Negrito tribes of that country who are already on the point of extinction. He was not spared to publish his main work, which should have embodied the vast material which he had collected. And yet his essays and papers, as few as they have appeared in print, are of the greatest value. He was the pioneer of Melanesian anthropology. To quote the just appreciation of his successor in this field, Dr Finsch, some of his essays on this subject are true masterpieces. He combined personal observation with accurate anthropological measurements conducted over a series of years, and thus he became the best authority on Melanesian anthropology. He was the first to reject the opinion, which had for a long time been current with regard to the growth of the hair of the Melanesians. He showed that its mode of growing differs in no way from that of the Europeans' hair. To him belongs the merit of having drawn attention to the extreme variability of skin colour and of the breadth index amongst the Papuas. His demand, which he was the first boldly to put forth, that anthropological investigations should be based not so much on measurements, as on the study of anatomy carried on at the dissection table, is now more and more gaining recognition.

Although he has left no monograph on the ethnographic part

of his work, the student will find many valuable facts in his diaries which have been published. They give a vivid picture of the life and especially of the psychology of the natives of New Guinea, as seen by a man, who has for many years shared the most intimate sides of their everyday life.

Miklukho-Maklay closes the series of Russian explorers who carried out the work of exploration in the South Pacific during the XIXth century. Russian science, however, is confident that their work will be resumed by their successors. The growth of our ethnographical museums coupled with the development of ethnological science in Russia is ushering in a new generation who will, it is to be hoped, approach their work in the fine spirit of their predecessors.

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THE SPELLING OF RUSSIAN PERSONAL AND GEOGRAPHICAL NAMES ADOPTED IN THIS BOOK

Throughout this book, with few exceptions, Russian personal and geographical names are reproduced in English by the substitution for Russian letters of the following English characters with their equivalent sound values.

Russian characters.	English characters used.	Equivalent English sounds.	
а	a	as a	in father
б	b	„ b	„ be
„ at end of word	b (conventional)	„ p	„ up
в	v	„ v	„ vat
„ at end of word	v (conventional)	„ ff	„ off
г	g	„ g	„ give
„ at end of word	g (conventional)	„ ck	„ back
д	d	„ d	„ do
„ at end of word	d (conventional)	„ t	„ at
дж	j	„ j	„ joy
е	e	„ e	„ met
„ at beginning of word	e or ye	„ ye	„ yes
ж	zh (conventional)	„ z or s	„ azure, pleasure.
„ at end of word	„	„ sh	„ ash
з	z	„ z	„ zeal
„ at end of word	z (conventional)	„ s	„ us
и	i	„ i	„ machine
й final letter of diphtongs ай, ей, etc.	y or i	„ y or i	„ boy, bay, they, noise, etc.
к	k	„ k	„ keep
л	l	„ l	„ wealth
м	m	„ m	„ me
н	n	„ n	„ not
о	o	„ o	„ or
п	p	„ p	„ put

р	r	as rr	in warrant
с	s	„ s	„ so or us (never z sound of s)
т	t	„ t	„ to
у	u	„ u	„ true
ф	f	„ f	„ fall
х	kh (conventional)	„ ch	„ loch (Scottish)
ц	ts	„ ts	„ its
ч	ch	„ ch	„ church
ш	sh	„ sh	„ shall
щ	shch	„ shch	„ rash child (pronounced rapidly).
		or „ sch	„ mischief
ы	y (conventional)	as an undefinable semivowel sound in the adjectival suffix - ble (really the voiced l), as able, etc., only prolonged to the full sound of a vowel.	
ю	yu or iu	as yu	in yule
		or „ u	„ unite
я	ya or ia	„ ya	„ yard

1. The English letter „y“ in the above scheme is used conventionally only in the difficult vowel sound „ы“. In other cases, as in the transliteration of „я“, „ю“, „й“ it is employed in its English use. These different uses of „y“ need not be confounded, as „y“, as pronounced in English, is always joined to another vowel, whereas as employed for „ы„ it usually stands between two consonants.

2. Letters in Russian, as in most languages, often represent more than one sound each, as may be seen in the table above in the case of the consonants „б“, „в“, „г“, „д“, „ж“ and „з“. The same applies to certain vowels, such as „о“, which varies in pronunciation according to whether it is laid under stress or not. Thus, the accented „о“ is generally pronounced „о“, whereas unaccented it becomes an „а“.

3. The object of applying the above scheme of transliteration is to secure uniformity and also to render sufficiently intelligible to English speaking people the general pronunciaton of Russian sounds and to avoid the spelling of the letters in the usual conventional way, which is either misleading, or defies reproduction in articulate speach by persons not conversant with German or with Slav languages, using Latin characters.

Contents